Salmon Falls Creek Subbasin Total Maximum Daily Loads

2020 Temperature TMDLs

Hydrologic Unit Code ID17040213

State of Idaho
Department of Environmental Quality
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1410 North Hilton | Boise, ID | *www.deq.idaho.gov*

Prepared by
Idaho Department of Environmental Quality
Twin Falls Regional Office
650 Addison Avenue West, Suite 110
Twin Falls, ID 83301

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Abbreviations, Acronyms, and Symbols

§303(d)	refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
§	section (usually a section of federal or state rules or statutes)
BMP	best management practice
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
CGP	Construction General Permit
COLD	cold water aquatic life
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
EPA	United States Environmental Protection Agency
GIS	geographic information system
HUC	hydrologic unit code
IDAPA	refers to citations of Idaho administrative rules
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IPDES	Idaho Pollutant Discharge Elimination System
kWh	kilowatt-hour
LA	load allocation
LC	load capacity
m	meter
MDAT	maximum daily average temperature
MDMT	maximum daily maximum temperature
MOS	margin of safety
MWMT	maximum weekly maximum temperature
n/a	not applicable
NA	not assessed

NB	natural background
NFS	not fully supporting
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
PCR	primary contact recreation
PFC	proper functioning condition
PNV	potential natural vegetation
SFI	DEQ's Stream Fish Index
SHI	DEQ's Stream Habitat Index
SMI	DEQ's Stream Macroinvertebrate Index
SS	salmonid spawning
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
US	United States
USC	United States Code
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USGS	United States Geological Survey
WAG	watershed advisory group
WBAG	*Water Body Assessment Guidance*
WBID	water body identification number
WLA	wasteload allocation

Executive Summary

The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards).

States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 water bodies in Idaho's Integrated Report. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses fifteen water bodies (twenty-seven assessment units) in the Salmon Falls Creek subbasin that are included in Category 4a of Idaho's most recent federally approved Integrated Report (DEQ, 2020).

This document describes the key physical and biological characteristics of the subbasin; water quality concerns and status; pollutant sources; and recent pollution control actions in the Salmon Falls Creek subbasin, located in southern Idaho. For more detailed information about the subbasin and previous TMDLs, see the Salmon Falls Creek Subbasin Assessment and Total Maximum Daily Loads (DEQ, 2007).

The TMDL analysis establishes water quality targets and load capacities, estimates existing pollutant loads, and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards. It also identifies implementation strategies—including reasonable time frames, approach, responsible parties, and monitoring strategies—necessary to achieve load reductions and meet water quality standards.

Subbasin at a Glance

The Salmon Falls Creek subbasin is located in southern Idaho (Figure A). Major streams and their tributaries are covered in this TMDL; including Shoshone Creek, Salmon Falls Creek, House Creek, and Cedar Creek. The streams analyzed in this TMDL require temperature reductions to support designated and presumed beneficial uses of cold water aquatic life and salmonid spawning.

TMDLs in this subbasin are being reestablished using stream shade curves specific to Idaho. The 2007 TMDL used stream shade curves from neighboring states or other regions of Idaho that hold similar vegetation communities but are not directly comparable to conditions observed in the Salmon Falls Creek subbasin. Using stream shade curves developed specifically for vegetation communities in Idaho more accurately portrays conditions within the subbasin and the amount of solar input a stream receives.

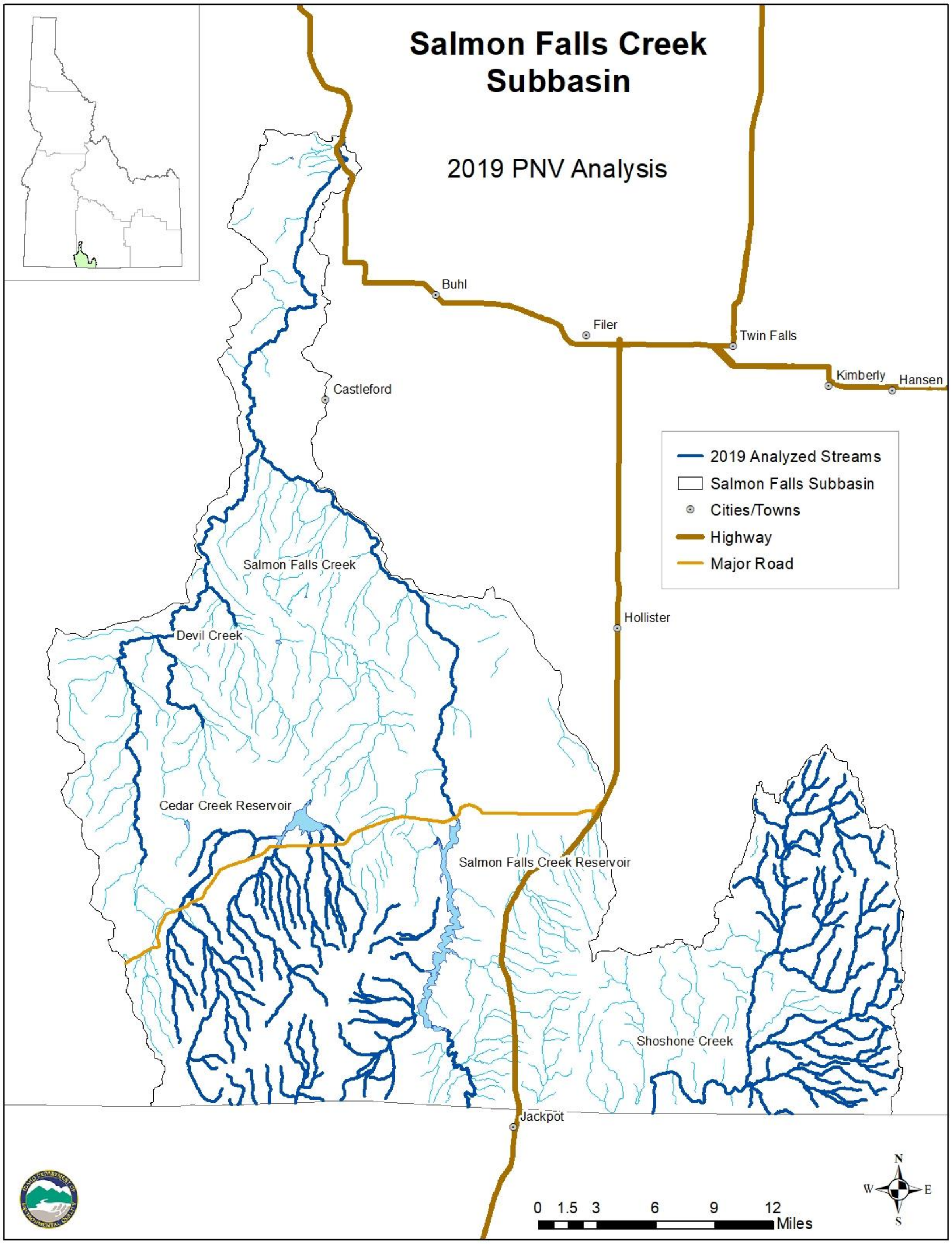

Figure A. Salmon Falls Creek subbasin.

TMDLs were set using targets for solar load at levels to restore support of beneficial uses (cold water aquatic life and salmonid spawning). These targets equate to what the solar load would be for a stream at potential natural vegetation (PNV). The PNV represents the system potential vegetation of a riparian system absent any other human disturbance. The system potential vegetation includes communities of different age classes and the results of natural disturbance.

Key Findings

The waterbodies addressed in this document were identified and placed on the §303(d) list of impaired waters, or subsequent lists, for temperature criteria violations. The Idaho Department of Environmental Quality (DEQ) developed temperature TMDLs for these waters (Table A). TMDLs for other pollutants in the subbasin are set under separate cover and include impairments (e.g., total suspended solids, nitrogen, phosphorus, sedimentation/siltation, *Escherichia coli*). This document only addresses flowing waters—any identified lakes included in the 2016 Integrated Report will be addressed separately.

Effective target shade levels were established for 27 assessment units (AU) based on the concept of maximum shading under PNV resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation that was partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho’s water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table B.

Most streams within the subbasin require significant reductions in solar load to meet PNV targets. Streams where substantial restoration and conservation have occurred (e.g., Shoshone Creek) are close to meeting solar targets. These streams may have solar loads within the margin of safety, indicating that those streams are functioning at or near their ecological potential for stream shading. Some streams (e.g., Hot Creek) are meeting their solar targets and require further investigation to determine if they are functioning in full support of designated or presumed beneficial uses. Other background conditions may be preventing attainment of full support and a use attainability analysis may be warranted.

Table A. Water bodies and pollutants for which TMDLs were developed or investigated.

Water Body	Assessment Unit	Pollutant
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	Temperature, water
Devil Creek	ID17040213SK002_03	Temperature, water
Devil Creek - 4th order segment to mouth	ID17040213SK002_04	Temperature, water
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	Temperature, water
01 & 02 tribs Cedar Creek Reservoir	ID17040213SK004_02	Temperature, water
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	Temperature, water
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	Temperature, water
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	Temperature, water
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	Temperature, water
China, Browns, Corral, Player Creeks	ID17040213SK008_02	Temperature, water
China Creek	ID17040213SK008_03	Temperature, water
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	Temperature, water
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_02	Temperature, water
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	Temperature, water
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	Temperature, water
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	Temperature, water
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	Temperature, water
Hot Creek	ID17040213SK012_03A	Temperature, water
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	Temperature, water
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	Temperature, water
Big Creek - source to mouth	ID17040213SK014_02	Temperature, water
Big Creek - source to mouth	ID17040213SK014_03	Temperature, water
Cottonwood Creek - source to mouth	ID17040213SK015_02	Temperature, water
Cottonwood Creek - source to mouth	ID17040213SK015_03	Temperature, water
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	Temperature, water
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	Temperature, water

Table B. Summary of assessment outcomes for assessment units in Category 4a of 2016 Integrated Report.

Water Body	Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Devil Creek	ID17040213SK002_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Devil Creek - 4th order segment to mouth	ID17040213SK002_04	Temperature	No	Remain in Category 4a	Intermittent system; TMDL could not be calculated.
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
01 & 02 tribs Cedar Creek Reservoir	ID17040213SK004_02	Temperature	No	Remain in Category 4a	Intermittent system; TMDL could not be calculated.
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
China, Browns, Corral, Player Creeks	ID17040213SK008_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)

China Creek	ID17040213SK008_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek	ID17040213SK012_03A	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)

Big Creek - source to mouth	ID17040213SK014_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Big Creek - source to mouth	ID17040213SK014_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cottonwood Creek - source to mouth	ID17040213SK015_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cottonwood Creek - source to mouth	ID17040213SK015_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)

Public Participation

The Mid Snake Watershed Advisory Group (WAG), other agencies, nongovernment organizations, and the public played a significant role in TMDL development processes. The continued participation of the WAG will be critical during and after the public comment period, and in implementing the TMDL.

Introduction

This document addresses twenty-six AUs in the Salmon Falls Creek subbasin that have been placed in Category 4a of Idaho's most recent federally approved Integrated Report (DEQ, 2020). The purpose of this total maximum daily load (TMDL) is to update solar target loads and characterize and document pollutant loads within the Salmon Falls Creek subbasin. The first portion of this document presents key characteristics or updated information for the subbasin assessment, which is divided into four major sections: subbasin characterization (section 1), water quality concerns and status (section 2), pollutant source inventory (section 3), and a summary of past and present pollution control efforts (section 4). While the subbasin assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up-to-date and accurate.

The subbasin assessment is used to develop a TMDL for each pollutant of concern for the Salmon Falls Creek subbasin. The TMDL (section 5) is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (40 CFR Part 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant. Effective shade targets were established for twenty-seven AUs based on the concept of maximum shading under potential natural vegetation (PNV) resulting in natural background temperatures.

Regulatory Requirements

This document was prepared in compliance with both federal and state regulatory requirements. The federal government, through the United States Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Idaho Department of Environmental Quality (DEQ) implements the Clean Water Act in Idaho, while EPA oversees Idaho and certifies the fulfillment of Clean Water Act requirements and responsibilities.

Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act, in 1972. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 USC §1251). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The Clean Water Act has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to ensure "swimmable and fishable" conditions. These goals relate water quality to more than just chemistry.

The Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the Clean Water Act, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. DEQ must review those standards every 3 years, and EPA must approve Idaho's water quality standards. Idaho adopts water quality standards to protect public health and welfare, enhance water quality, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 waters in Idaho's Integrated Report. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

DEQ monitors waters, and for those not meeting water quality standards, DEQ must establish a TMDL for each pollutant impairing the waters. However, some conditions that impair water quality do not require TMDLs. EPA considers certain unnatural conditions—such as flow alteration, human-caused lack of flow, or habitat alteration—that are not the result of discharging a specific pollutant as "pollution." TMDLs are not required for water bodies impaired by pollution, rather than a specific pollutant. A TMDL is only required when a pollutant can be identified and in some way quantified.

1 Subbasin Characterization

There are a variety of land types found within the Salmon Falls Creek subbasin. The low mountains and sage-steppe habitats are the predominant land type within the subbasin and contain the majority of the subbasin's water. Adjacent to these lands, in the lower elevations of the subbasin where access is easier, are agricultural, pastureland, and row crop activities. The water sources vary throughout the subbassin. In the eastern mountainous areas, water primarily comes from rainfall and winter snowpack. In the western hills, smaller streams originate as springs.

Hydrologic modifications have significantly altered Cedar Creek and Salmon Falls Creek. Cedar Creek has essentially remained dry below its dam and Salmon Falls Creek relies on gaining water from seeps around the dam, springs, and irrigation returns to maintain downstream flow. Other streams in the central areas of the subbasin are ephemeral or intermittent as the historic stream channels work their way through the dry hills and sagebrush desert of Devil's Creek. A complete description of the climate, subwatershed, and cultural characteristics can be found in the original TMDL (DEQ, 2007).

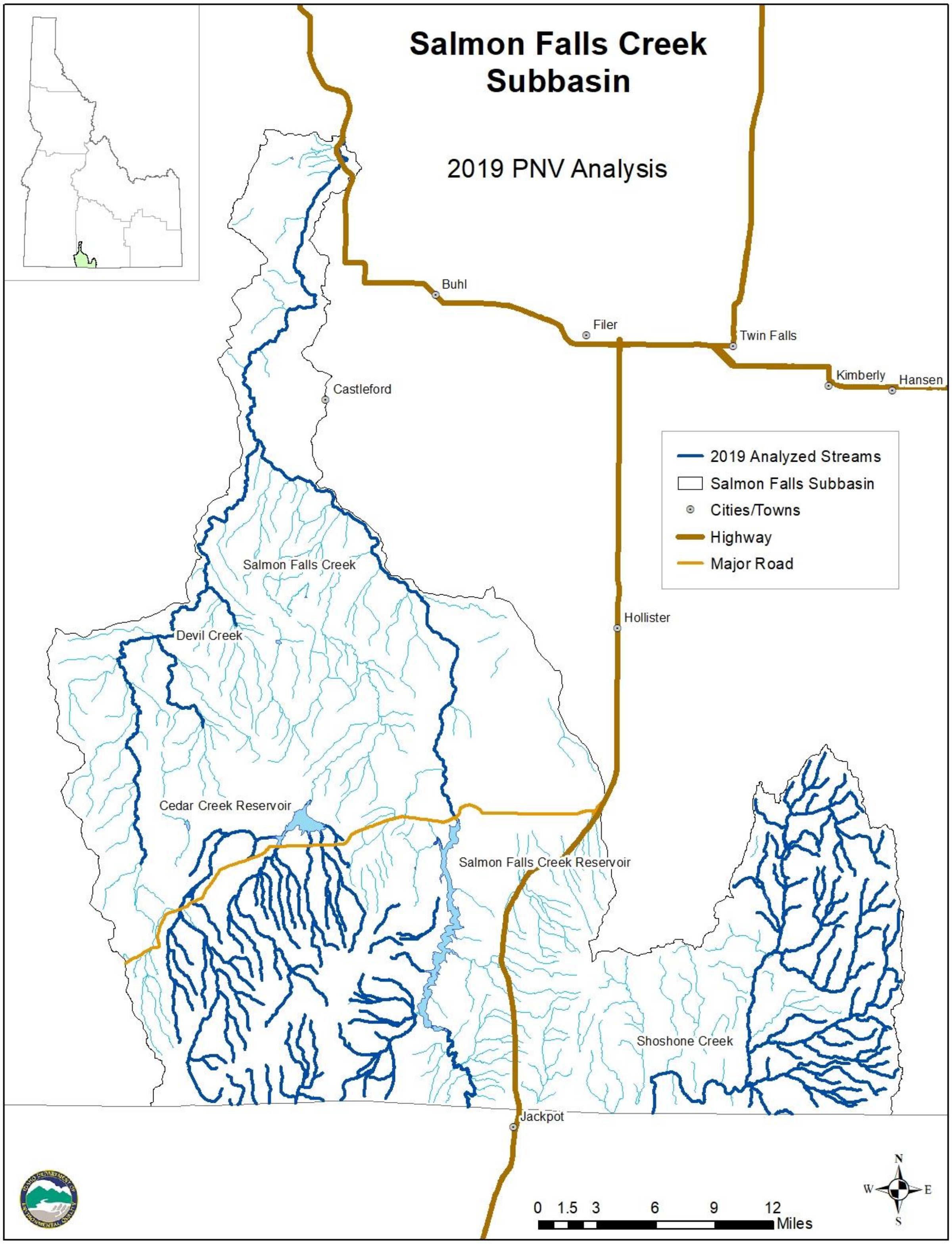

Figure 1. Salmon Falls Creek subbasin.

2 Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

Section 303(d) of the Clean Water Act states that waters that are unable to support their beneficial uses and do not meet water quality standards must be listed as water quality limited. Subsequently, these waters are required to have TMDLs developed to bring them into compliance with water quality standards.

2.1.1 Assessment Units

Assessment units (AUs) are groups of similar streams that have similar land use practices, ownership, or land management. However, stream order is the main basis for determining AUs—even if ownership and land use change significantly, the AU usually remains the same for the same stream order.

Using AUs to describe water bodies offers many benefits, primarily that all waters of the state are defined consistently. AUs are a subset of water body identification numbers, which allows them to relate directly to the water quality standards.

2.1.2 Listed Waters

Table 1 presents each AU in the subbasin analyzed as part of this TMDL (i.e., AUs in Category4a of the Integrated Report). AUs in Category 4a of the Integrated Report are those that have had a TMDL completed and approved by EPA. The most recently approved TMDL for the Salmon Falls subbasin was in 2008.

Table 1. Salmon Falls Creek subbasin Category 4a temperature impaired assessment units in the subbasin.

Water Body	Assessment Unit	Pollutant
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	Temperature, water
Devil Creek	ID17040213SK002_03	Temperature, water
Devil Creek - 4th order segment to mouth	ID17040213SK002_04	Temperature, water
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	Temperature, water
01 & 02 tribs Cedar Creek Reservoir	ID17040213SK004_02	Temperature, water
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	Temperature, water
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	Temperature, water
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	Temperature, water
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	Temperature, water
China, Browns, Corral, Player Creeks	ID17040213SK008_02	Temperature, water
China Creek	ID17040213SK008_03	Temperature, water
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	Temperature, water
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_02	Temperature, water
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	Temperature, water
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	Temperature, water
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	Temperature, water
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	Temperature, water
Hot Creek	ID17040213SK012_03A	Temperature, water
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	Temperature, water
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	Temperature, water
Big Creek - source to mouth	ID17040213SK014_02	Temperature, water
Big Creek - source to mouth	ID17040213SK014_03	Temperature, water
Cottonwood Creek - source to mouth	ID17040213SK015_02	Temperature, water
Cottonwood Creek - source to mouth	ID17040213SK015_03	Temperature, water
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	Temperature, water

Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	Temperature, water

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for waters of the state. Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as described briefly in Appendix A. The Water Body Assessment Guidance (DEQ 2016) provides a more detailed description of beneficial use identification for use assessment purposes.

Beneficial uses include the following:

- Aquatic life support—cold water, seasonal cold water, warm water, salmonid spawning, and modified
- Contact recreation—primary (e.g., swimming) or secondary (e.g., boating)
- Water supply—domestic, agricultural, and industrial
- Wildlife habitats
- Aesthetics

2.2.1 Beneficial Uses in the Subbasin

Temperature is a water quality value directly linked to the life cycle of fish and other aquatic species. Natural factors that influence stream temperature are elevation, channel orientation, climate, riparian vegetation, and channel shape. Human factors that influence stream temperature are point source discharges, riparian zone alteration, channel alteration, and flow alteration.

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations (e.g., food availability, low dissolved oxygen). Acceptable temperature ranges vary for different fish species, but the cold water fish are the least tolerant of high water temperatures. Juvenile fish are more vulnerable to increased stream temperatures. Common consequences for fish exposed to excess are decreases to vitality and survivability (DEQ, 2007).

Table 2 presents the identified beneficial uses of streams in Category 4a within the Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS) database analyzed as part of this TMDL.

Table 2. Salmon Falls Creek subbasin beneficial uses of 2016 IR temperature impaired Category 4a streams.

Water Body	Assessment Unit	Beneficial Uses	Type of Use
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	COLD SS PCR	Designated
Devil Creek	ID17040213SK002_03	COLD	Presumed
Devil Creek - 4th order segment to mouth	ID17040213SK002_04	COLD	Presumed
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	COLD SS PCR	Designated
01 & 02 tribs Cedar Creek Reservoir	ID17040213SK004_02	COLD	Presumed
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	COLD SS	Existing
		SCR	Presumed
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	COLD SCR	Presumed
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	COLD	Designated
		SS	Existing
		SCR	Presumed
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	COLD SCR	Presumed
China, Browns, Corral, Player Creeks	ID17040213SK008_02	COLD SS	Existing
		SCR	Presumed
China Creek	ID17040213SK008_03	COLD SS	Existing
		SCR	Presumed
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	COLD SS PCR	Designated
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_02	COLD SS	Existing
		SCR	Presumed
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	COLD	Existing
		SS SCR	Presumed
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	COLD SS	Existing
		SCR	Presumed

Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	COLD	Presumed
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	COLD	Presumed
Hot Creek	ID17040213SK012_03A	COLD SCR	Presumed
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	COLD	Existing
		SCR	Presumed
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	COLD SS SCR	Presumed
Big Creek - source to mouth	ID17040213SK014_02	COLD SS	Existing
		SCR	Presumed
Big Creek - source to mouth	ID17040213SK014_03	COLD SCR	Presumed
Cottonwood Creek - source to mouth	ID17040213SK015_02	COLD	Existing
		SS SCR	Presumed
Cottonwood Creek - source to mouth	ID17040213SK015_03	COLD SCR	Presumed
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	COLD SS	Existing
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	COLD SS	Existing
		SCR	Presumed

a Cold water (COLD), salmonid spawning (SS), primary contact recreation (PCR), secondary contact recreation (SCR)

Existing beneficial uses are not designated or presumed, but supported by an AU based on evidence collected through DEQ's water quality monitoring program. Additional data from other agencies or groups may be considered in determining an existing use. Protections associated with the designated and existing uses of salmonid spawning throughout the subbasin should be extended to all waters addressed with a TMDL in this document. Appendix A further describes the protections offered to existing beneficial uses.

2.2.2 Water Quality Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of water quality criteria, which include numeric criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (Appendix B) and narrative criteria for pollutants such as sediment and nutrients (IDAPA 58.01.02.250–251). For more about temperature criteria and natural background provisions relevant to the PNV approach, see Appendix B.

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.050.02. The procedure relies heavily upon biological parameters and is presented in detail in the Water Body Assessment Guidance (DEQ 2016). This guidance requires DEQ to use the most complete data available to make beneficial use support status determinations.

2.3 Summary and Analysis of Existing Water Quality Data

Table 3 provides the Beneficial Use Reconnaissance Program (BURP) data related to cold water aquatic life beneficial use support that were collected since 2015. An additional 31 sampling locations were visited to collect BURP data, but index scores could not be generated because the stream was dry, no flow was present, or the site was inaccessible. A more complete picture of the BURP sites visited can be seen on DEQ's 2018/2020 Integrated Report mapping tool at *https://mapcase.deq.idaho.gov/wq2020/default.html*. Seventeen BURP locations had passing scores, with an average index score of 2.00 or better. A full description of index scores can be found in DEQ's water body assessment guidance (DEQ, 2016).

Table 3. BURP (2015–2019) stream index scores for the Salmon Falls Creek subbasin.

Location ID	Assessment Unit Name	Assessment Unit ID	SMI2	SFI2	SHI2	Average
2015STWFA021	China Creek	ID17040213SK008_02	3	1	3	2.33
2015STWFA024	UNT to China Creek	ID17040213SK008_02	1	—	2	1.50
2015STWFA026	Little House Creek	ID17040213SK005_02	1	1	2	1.33
2015STWFA028	Big Creek	ID17040213SK014_03	2	2	2	2.00
2015STWFA029	Big Creek	ID17040213SK014_02	3	2	3	2.67
2015STWFA043	Shoshone Creek	ID17040213SK011_04	1	2	2	1.67
2015STWFA044	North Fork Salmon Falls Creek	ID17040213SK010_02	2	1	2	1.67
2015STWFA046	House Creek	ID17040213SK005_03	2	1	3	2.00
2015STWFA047	Cedar Creek	ID17040213SK006_02	2	2	2	2.00
2016STWFA002	Shoshone Creek	ID17040213SK016_03	2	—	2	2.00
2016STWFA005	Shoshone Creek	ID17040213SK011_04	2	2	3	2.33
2016STWFA046	UNT to China Creek	ID17040213SK008_02	2	—	2	2.00
2016STWFA060	Salmon Falls Creek	ID17040213SK007_06	2	—	1	1.50
2016STWFA061	Salmon Falls Creek	ID17040213SK009_06	2	—	1	1.50
2017STWFA016	Shoshone Creek	ID17040213SK012_04	2	3	2	2.33
2017STWFA017	Hot Creek	ID17040213SK012_03A	2	2	3	2.33
2017STWFA020	Shoshone Creek	ID17040213SK011_04	3	2	3	2.67
2017STWFA036	Little House Creek	ID17040213SK005_02	2	2	3	2.33
2017STWFA045	South Fork Shoshone Creek	ID17040213SK016_03	1	2	2	1.67
2018STWFA011	China Creek	ID17040213SK008_02	3	1	3	2.33
2018STWFA012	House Creek	ID17040213SK005_03	1	—	2	1.50
2018STWFA016	Cedar Creek	ID17040213SK006_03	3	—	2	2.50
2018STWFA026	Shoshone Creek	ID17040213SK011_04	1	3	3	2.33
2018STWFA027	Shoshone Creek	ID17040213SK012_04	2	2	2	2.00
2018STWFA033	Big Creek	ID17040213SK014_02	1	—	2	1.50
2018STWFA034	Big Creek	ID17040213SK014_03	1	—	2	1.50
2018STWFA059	Salmon Falls Creek	ID17040213SK007L_0L	1	1	1	1.00
2018STWFA060	Salmon Falls Creek	ID17040213SK009_06	3	1	1	1.67
2018STWFA079	Shoshone Creek	ID17040213SK011_04	2	3	1	2.00
2019STWFA017	Shoshone Creek	ID17040213SK013_04	—	2	1	1.50
2019STWFA031	Big Creek	ID17040213SK014_02	—	1	2	1.50

Shading indicates passing BURP score

From 2017 to 2019, temperature data were collected at 18 locations throughout the subbasin. Data collection efforts were collected in 60-minute intervals, to the extent that conditions and staffing allowed, to cover the spring salmonid spawning time frame and the cold water aquatic life critical time period of June 21 to September 21. Appendix C presents the collected water temperature data and data summaries for each monitored location. Appendix C presents the locations of temperature loggers. Full charts of the collected data and summaries in relation to cold water aquatic life and salmonid spawning are presented in Appendix C.

Stream temperature monitoring from 2017 to 2019 indicated that temperatures above the salmonid spawning criteria are persistent and common (Appendix C). Exceedances of the cold water aquatic life criteria are less common, but only a handful of streams (i.e. Pole Camp Creek, 2nd order SF Shoshone Creek, Browns Creek, Cedar Creek) met this criteria during the monitoring periods. Pole Camp Creek and the 2nd order AU of SF Shoshone Creek are within the Shoshone Creek - source to Cottonwood Creek AU (ID17040213SK016_02). The AU where temperature was monitored in Brown's Creek was the China, Browns, Corral, Player Creeks AU (ID17040213SK008_02) and the segment of Cedar Creek that did not violate the cold water aquatic life standard was the 2nd order Cedar Creek - source to Cedar Creek Reservoir AU (ID17040213SK006_02). Stream temperatures in the subbasin were observed to peak in late June through July.

2.3.1 Status of Beneficial Uses

Temperature TMDLs were updated for AUs in the Salmon Falls Creek subbasin. Excess temperature can affect the beneficial use of cold water aquatic life by disrupting all life stages of cold water dependent fish. Temperature as a constant stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity (DEQ, 2007). Juvenile fish can experience negative impacts (e.g., slower growth rates) at a lower threshold than adult fish. High water temperatures can also affect the development of fish in the egg.

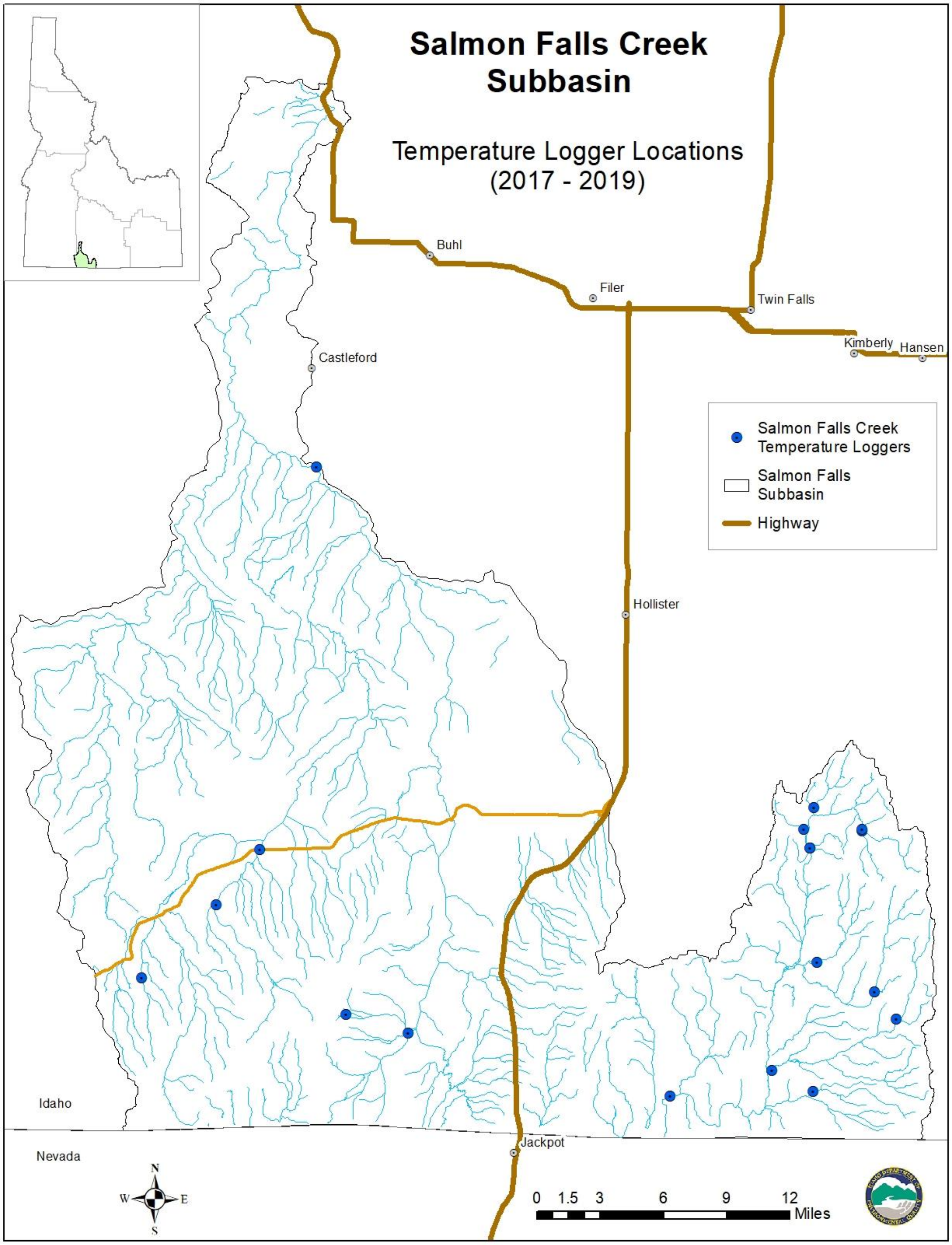

Figure 2. Stream temperature monitoring locations in Salmon Falls Creek subbasin (2017-2019).

2.3.2 Assessment Unit Summary

A summary of the data analysis, literature review, and field investigations and a list of conclusions for AUs included in Category 4a of the 2016 Integrated Report follows. This section includes changes that will be documented in the next Integrated Report once the TMDLs in this document have been approved by EPA.

2.3.2.1 Assessment Units Addressed in TMDLs

ID17040213SK001_06, Salmon Falls Creek - Devil Creek to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK002_03, Devil Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.
- One portion of this AU was visited in July of 2019 was holding water. The duration of water presence in the stream bed was not confirmed through a return visit. Future visits should be made to the stream to confirm the presence and duration of water.
- 2019 loads are based on the stream segments established in the 2007 TMDL. Loads for intermittent sections in downstream portions of the AU were not calculated in either TMDL.
- Surface water may be present in some years, but may not be present for a large enough portion of the year to establish and maintain aquatic life.

ID17040213SK002_04, Devil Creek - 4th order segment to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- This AU is identified as an intermittent system within the high-resolution National Hydrography Dataset at 1:24,000 scale.
- It was presumed that the AU would be dry for most or all of the critical time period for aquatic life and shade analysis was not completed.

ID17040213SK003_06, Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.

- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK004_02, Salmon Falls Creek - 01 & 02 tribs Cedar Creek Reservoir

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- This AU is identified as an intermittent system within the high-resolution National Hydrography Dataset at 1:24,000 scale.
- It was presumed that the AU would be dry for most or all of the critical time period for aquatic life and shade analysis was not completed.

ID17040213SK005_02, House Creek - source to Cedar Creek Reservoir

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK005_03, House Creek - source to Cedar Creek Reservoir

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK006_02, Cedar Creek - source to Cedar Creek Reservoir

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK006_03, Cedar Creek - source to Cedar Creek Reservoir

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.

- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK008_02, China, Browns, Corral, Player Creeks

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK008_03, China Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK009_06, Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use, and requires new EPA approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK010_02, North Fork Salmon Falls Creek-source to Idaho/Nevada border

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK010_03, North Fork Salmon Falls Creek-source to Idaho/Nevada border

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK011_04, Shoshone Creek - Hot Creek to Idaho/Nevada border

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK012_02, Hot Creek - Idaho/Nevada border to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK012_03, Hot Creek - Idaho/Nevada border to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show that target shade conditions are currently being met and no solar load reductions are required for this AU. Additional data collection is necessary to determine if this AU can be considered for delisting based on the natural background provision of Idaho surface water standards.

ID17040213SK012_03A, Hot Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use, and requires new EPA approved TMDLs.
- Data show that target shade conditions are currently being met and no solar load allocation is set for this AU. Additional data collection is necessary to determine if this AU can be considered for delisting based on the natural background provision of Idaho surface water standards.
- Passing BURP scores were calculated for this AU in 2017. The macroinvertebrate and fish index values were at a 2 and the habitat index value was at a 3. Averaged index values greater than 2 indicate full support of cold water aquatic life beneficial uses.

ID17040213SK012_04, Hot Creek - Idaho/Nevada border to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK013_04, Shoshone Creek - Cottonwood Creek to Hot Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK014_02, Big Creek - source to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK014_03, Big Creek - source to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK015_02, Cottonwood Creek - source to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.
- Cliff Spring, a stream in the AU, was visited on July 10, 2019 and was found to be dry. Other portions of this AU should be visited at different times of the summer to help document the presence and duration of water..

ID17040213SK015_03, Cottonwood Creek - source to mouth

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK016_02, Shoshone Creek - source to Cottonwood Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

ID17040213SK016_03, Shoshone Creek - source to Cottonwood Creek

- Listed for temperature.
- This AU is listed in Category 4a with an approved TMDL for temperature.
- The 2007 TMDL used different shade curves than those currently in use and requires new EPA-approved TMDLs.
- Data show shade conditions are not met and solar load allocation is set in Section 5 of this document.

3 Pollutant Source Inventory

Pollution within the Salmon Falls Creek subbasin is primarily from nutrients, sedimentation, and water temperature. Load allocations were established in the Salmon Falls Creek Subbasin Assessment and Total Maximum Daily Loads approved by EPA in 2008 (DEQ, 2007).

Excess sediment in the substrate of a stream decreases natural hydrologic functioning and restricts habitat for aquatic wildlife. Eroding streambanks become unstable and cannot support deep-rooted vegetation. Higher amounts of vegetative cover hold streambanks together with root masses, but as streambanks erode and vegetative cover is lost, erosion is accelerated. Loss of vegetative cover increases solar radiation to the water surface. Without vegetative shading on the streambanks, the temperature of the stream increases and aquatic wildlife must seek out cooler habitats upstream or in alternate locations.

3.1 Point Sources

Point sources of pollution are affiliated with known discrete discharges and are now regulated through the Idaho Pollution Discharge Elimination System (IPDES). On June 5, 2018, the EPA approved the application by the State of Idaho to administer and enforce the IPDES program.

This transfer of permitting authority from EPA to Idaho will happen over a four-year period as listed below. EPA is still the permitting authority for stormwater permits until July 1, 2021.

- Phase I – Individual Municipal Permits and Pretreatment on July 1, 2018.
- Phase II – Individual Industrial Permits on July 1, 2019.
- Phase III – General Permits (Aquaculture, Pesticide, CAFO, Suction Dredge, Remediation) on July 1, 2020.
- Phase IV – Federal Facilities, General and Individual Stormwater Permits and Biosolids on July 1, 2021.

Three permitted point source facilities exist or have existed in the Salmon Falls Creek subbasin (Table 4). Two of the permitted point sources, the concentrated animal feeding operations (CAFO), have terminated permits and are not expected to discharge any additional wastewater. The remaining permit is associated with construction stormwater activities. Those activities are regulated by the implementation of best management practices (BMPs), permitted by the EPA, and state certified to maintain current water quality with no further degradation. Average annual precipitation as measured at the Twin Falls Regional Airport is approximately 9.5 inches with a monthly average of 0.8 inches. The majority of the precipitation comes in the spring and winter and dry summers are normal.

The EPA will still issue general permits for stormwater discharges from construction sites until July 2021. In some circumstances, the operator is required to apply for a construction general permit (CGP) from EPA after developing a site-specific stormwater pollution prevention plan (SWPPP). The SWPPP must provide the intended erosion, sediment, and pollution controls; periodic inspection of the controls; and maintenance of BMPs throughout the life of the project. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the IPDES program and implement the appropriate BMPs.

Conditions within the CGP result in stormwater discharges being controlled as necessary to meet applicable water quality standards. Additional conditions in the CGP relevant to the State of Idaho provide base level, Tier I protection that ensures existing uses of a water body and the level of water quality necessary to protect those uses will be maintained and protected. Additional protections, Tier II, may be applied in temperature-impaired streams if the biological or aquatic habitat parameters show a healthy, balanced biological community. Tier II protections are reserved for high-quality water bodies and ensures that no lowering of water quality will be allowed unless necessary to accommodate important development. The primary pollutants of concern associated with stormwater discharges from construction activities are sediment, phosphorus, nitrogen, pesticides, organics, metals, polychlorinated biphenyls, petroleum products, construction chemicals, and solid wastes (EPA, 2019). For more information about these permits and managing stormwater, see Appendix D.

Table 4. IPDES-permitted point sources in the Salmon Falls Creek subbasin.

ID#	Facility Name	NPDES Type	Affected Drainage and AU	Comments
IDG010108	Eagle View Farm	Concentrated Animal Feeding Operation	Salmon Falls Creek ID17040213SK001_02	Permit terminated. No effects anticipated. Not a TMDL water.
IDG010144	Nunes Family Dairy	Concentrated Animal Feeding Operation	Irrigation canals and ditches	Permit terminated. No effects anticipated.
IDR1001RK	Salmon Falls Creek Bridge	ICIS-NPDES Non-Major	Salmon Falls Creek ID17040213SK001_06	BMP regulated and state certified. No effects anticipated.

No wasteload allocations are proposed for the Salmon Falls Creek subbasin.

3.2 Nonpoint Sources

Because this TMDL is based on PNV-style riparian shade calculations, which are equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, in order to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade. Therefore, load allocations are stream segment specific and dependent on the target load for a given segment. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent on background conditions for achieving water quality standards, all tributaries to the examined waters need to reflect natural conditions to prevent excess heat loads to the system.

3.3 Pollutant Transport

Pollutant transport refers to the pathway pollutants take from the pollutant source to cause a problem or water quality violation in the receiving water body. In the case of temperature, most pollutant transport is in the form of solar radiation directly to the stream as a result of exposure.

4 Summary of Pollution Control Efforts and Monitoring

DEQ examined the shade conditions on perennial water bodies in the Salmon Falls Creek subbasin. The results are presented below in Section 5. Shade was evaluated through aerial photo interpretation of 2017 National Agricultural Imagery Program imagery. Solar Pathfinder monitoring of shade has taken place at 12 sites in the watershed for the purpose of calibrating and enhancing the aerial interpretation.

Excess solar loads from the 2007 Salmon Falls Creek TMDL were reviewed to determine if it was possible to identify any general trends for solar loads in the subbasin. The 2007 TMDL used stream segments not based on AUs, and only classified shade on the mainstem portions of streams and major tributaries. Solar loads were organized by geographic locations of streams that are not directly comparable to the AU-based analysis completed as part of this TMDL. While not directly comparable, excess solar loads from the 2007 analysis may provide particular insight as to the overall condition of solar loads within the subbasin. Table 5 presents excess solar loads calculated as part of the 2007 TMDL analysis.

Table 5. Excess solar loads and percent reductions for streams and tributaries from the 2007 analysis in the Salmon Falls Creek subbasin.

Water Body	Excess Load (kWh/day) (% Reduction)
Salmon Falls Creek below reservoir	817,208 (20%)
Salmon Falls Creek above reservoir	263,967 (12%)
Devil Creek	71,703 (33%)
House Creek	136,940 (31%)
Cedar Creek, below reservoir	107,427 (45%)
Cedar Creek, above reservoir	50,907 (41%)
China Creek	42,775 (47%)
Browns Creek	18,717 (64%)
Player Creek	8.335 (58%)
North Fork Salmon Falls Creek (Idaho portion)	16,405 (55%)
Shoshone Creek	783,328 (40%)
Hot Creek (Idaho portion)	25,756 (40%)
Big Creek	136,638 (38%)
Cottonwood Creek	151,580 (46%)

As detailed in following sections, waterbodies comprised of first and second order streams have been observed to require the largest solar load reductions throughout the subbasin. Larger streams, while providing relatively large solar loads, are closer to shade targets than smaller streams in the subbasin.

5 Total Maximum Daily Loads

A TMDL prescribes an upper limit (i.e., load capacity) on discharge of a pollutant from all sources to ensure water quality standards are met. It further allocates this load capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation, and nonpoint sources, each of which receives a load allocation. Natural background contributions, when present, are considered part of the load allocation but are often treated separately because they represent a part of the load not subject to control. Because of uncertainties about quantifying loads and the relation of specific loads to attaining water quality standards, the rules regarding TMDLs (40 CFR Part 130) require a margin of safety be included in the TMDL. Practically, the margin of safety and natural background are both reductions in the load capacity available for allocation to pollutant sources.

Load capacity can be summarized by the following equation:

$$LC = MOS + NB + LA + WLA = TMDL$$

Where:

LC = load capacity
MOS = margin of safety
NB = natural background
LA = load allocation
WLA = wasteload allocation

The equation is written in this order because it represents the logical order in which a load analysis is conducted. First, the load capacity is determined. Then the load capacity is broken down into its components. After the necessary margin of safety and natural background, if relevant, are quantified, the remainder is allocated among pollutant sources (i.e., the load allocation and wasteload allocation). When the breakdown and allocation are complete, the result is a TMDL, which must equal the load capacity.

The load capacity must be based on critical conditions—the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determining critical conditions can be more complicated than it may initially appear.

Another step in a load analysis is quantifying current pollutant loads by source. This step allows for the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. A load is fundamentally a quantity of pollutant discharged over some period of time and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for "other appropriate measures" to be used when necessary (40 CFR 130.2). These other measures must still be quantifiable and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow "gross allotment" as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

For the Salmon Falls Creek subbasin temperature TMDLs, we utilized a PNV approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and for temperature TMDLS, the natural level of shade and channel width become the TMDL target. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. See Appendix B for further discussion of water quality standards and natural background provisions.

The PNV approach is described briefly below. The procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in detail in The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual (Shumar and De Varona 2009). The manual also provides a more complete discussion of shade and its effects on stream water temperature.

5.1.1 Factors Controlling Water Temperature in Streams

There are several important contributors of heat to a stream, including ground water temperature, air temperature, and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most controllable. The parameters that affect the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology (i.e., structure) affects riparian vegetation density and water storage in the alluvial aquifer. Riparian vegetation and channel morphology are the factors influencing shade that are most likely to have been influenced by anthropogenic activities and can be most readily corrected and addressed by a TMDL.

Riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. However, depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can also provide shade. We can measure the amount of shade that a stream receives in a number of ways. Effective shade (i.e., that shade provided by all objects that intercept the sun as it makes its way across the sky) can be measured in a given location with a Solar Pathfinder or with other optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and stream aspect.

In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream and can be measured using a densiometer or estimated visually either on-site or using aerial photography. All of these methods provide information about how much of the stream is covered and how much is exposed to direct solar radiation.

5.1.2 Potential Natural Vegetation for Temperature TMDLs

PNV along a stream is that riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. Vegetation can be removed by disturbance either naturally (e.g., wildfire, disease/old age, wind damage, wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream without any anthropogenic removal of shade-producing vegetation. Vegetation levels less than PNV (with the exception of natural levels of disturbance and age distribution) result in the stream heating up from anthropogenically created additional solar inputs.

We can estimate PNV (and therefore target shade) from models of plant community structure (shade curves for specific riparian plant communities), and we can measure or estimate existing canopy cover or shade. Comparing the two (target and existing shade) tells us how much excess solar load the stream is receiving and what potential exists to decrease solar gain. Streams disturbed by wildfire, flood, or some other natural disturbance will be at less than PNV and require time to recover. Streams that have been disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing and PNV shade was converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this case, we used a hybrid factor that is an average between those from the Boise and Pocatello stations. The difference between existing and target solar loads, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards (Appendix B).

PNV shade and the associated solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural (so long as no point sources or other anthropogenic sources of heat exist in the watershed) and are considered to be consistent with the Idaho water quality standards, even if they exceed numeric criteria by more than 0.3 °C.

5.1.2.1 Existing Shade Estimates

Existing shade was estimated for twenty-five AUs from visual interpretation of aerial photos. Estimates of existing shade based on plant type and density were marked out as stream segments on a 1:100,000 or 1:250,000 hydrography taking into account natural breaks in vegetation density. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process, IDL 2000). For example, if shade for a particular stream segment was estimated somewhere between 50% and 59%, we assigned a 50% shade class to that segment. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and stream width. Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

Visual estimates made from aerial photos are strongly influenced by canopy cover and do not always take into account topography or any shading that may occur from physical features other than vegetation. It is not always possible to visualize or anticipate shade characteristics resulting from topography and landform. However, research has shown that shade and canopy cover measurements are remarkably similar (OWEB 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade. The visual estimates of shade in this TMDL were partially field verified with a Solar Pathfinder, which measures effective shade and takes into consideration other physical features that block the sun from hitting the stream surface (e.g., hillsides, canyon walls, terraces, and man-made structures).

Solar Pathfinder Field Verification

The accuracy of the aerial photo interpretations was field verified with a Solar Pathfinder at twelve sites. The Solar Pathfinder is a device that allows one to trace the outline of shade-producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the location where the tracing is made. To adequately characterize the effective shade on a stream segment, twenty traces are taken at systematic or random intervals along the length of the stream in question.

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bankfull water level. Twenty traces were taken following the manufacturer's instructions (i.e., orient to south and level). Systematic sampling was used because it is easiest to accomplish without biasing the sampling location. For each sampled segment, the sampler started at a unique location, such as 25 to 50 meters (m) from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 25 m, 25 paces, etc.). Alternatively, one can randomly locate points of measurement by generating random numbers to be used as interval distances.

When possible, the sampler also measured bankfull widths, took notes, and photographed the landscape of the stream at several unique locations while taking traces. Special attention was given to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade-producing ones) were present. One can also take densiometer readings at the same location as Solar Pathfinder traces. These readings provide the potential to develop relationships between canopy cover and effective shade for a given stream.

Table 6 presents the Solar Pathfinder field verification of aerial photo interpretation for the Salmon Falls Creek subbasin. Overall, the data collected shows that shade was slightly underestimated for the subbasin, but that the true shade value is within one shade class of the measurement shown. Access to some locations may have been limited due to private property boundaries, or as in the case of lower Salmon Falls Creek, unwadeable water in the canyon bottom. Some sites were visited to confirm intermittent designations within the National Hydrography Dataset (NHD) 1:24k scale, such as Cliff Spring (AU ID17040213SK015_02) (Figure 3). This site was visited on July 10, 2019 and did not show any signs of recent water presence.

Figure 3. Photos from Cliff Spring Creek (AU ID17040213SK015_02). Upstream (L), Downstream (R).

Conversely, the third order Devil's Creek at Big Bend Crossing (AU ID17040213SK002_03) is identified in the NHD 1:24k scale as an intermittent stream. This stream is commonly known to not hold water and was visited July 12, 2019. At the time of the visit water was present in the stream channel as shown in Figure 4. DEQ was unable to determine the length or duration the water was present throughout the year. Future visits should be made to help make this determination.

Figure 4. Photos from Devil's Creek (AU ID17040213SK002_03). Upstream (L), Downstream (R).

Table 6. Solar Pathfinder field verification results for the Salmon Falls Creek subbasin.

Stream	AU	Site_ID	Aerial Classification	Pathfinder Measurement	Pathfinder Classification	Classification Difference
Browns Creek	ID17040213SK008_02	BROCRE-01	20	9	0	2
China Creek	ID17040213SK008_03	CHICRE-01	30	29	20	1
Cottonwood Creek	ID17040213SK015_02	COTCRE-01	20	53	50	-3
Devil Creek	ID17040213SK002_03	DEVCRE-01	0	7	0	0
Dry Gulch	ID17040213SK014_02	DRYGUL-01	40	79	70	-3
Little House Creek	ID17040213SK005_02	LIHCRE-01	30	59	50	-2
South Fork Shoshone Creek	ID17040213SK016_03	SFSCRE-01	10	18	10	0
South Fork Shoshone Creek	ID17040213SK016_02	SFSCRE-02	50	52	50	0
South Fork Shoshone Creek	ID17040213SK016_02	SFSCRE-03	90	73	70	2
Shoshone Creek	ID17040213SK013_04	SHOCRE-01	0	4	0	0
Shoshone Creek	ID17040213SK016_02	SHOCRE-03	80	77	70	1
Shoshone Creek	ID17040213SK016_02	SHOCRE-04	70	71	70	0
				Mean		-0.17
				Standard Deviation		1.62
				Confidence Level (95.0%)		0.92

5.1.2.2 Target Shade Determination

PNV targets were determined from an analysis of probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities in Idaho (Shumar and De Varona 2009). A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, shade decreases as vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width.

Natural Bankfull Widths

Stream width must be known to calculate target shade since the width of a stream affects the amount of shade the stream receives. Bankfull width is used because it best approximates the width between the points on either side of the stream where riparian vegetation starts. Measures of current bankfull width may not reflect widths present under PNV (i.e., natural widths). As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallower. Shade produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has eroded away.

Since, existing bankfull width may not be discernible from aerial photo interpretation and may not reflect natural bankfull widths, this parameter must be estimated from available information. We used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bankfull width (Figure 5).

For each stream evaluated in the load analysis, natural bankfull width was estimated based on the drainage area of the Upper Snake Basin regional curve from Figure 5. Although estimates from other curves were examined (i.e., Payette/Weiser and Bruneau/Owyhee), the Upper Snake curve was ultimately chosen because of its proximity to the Salmon Falls Creek subbasin. Width data was evaluated and compared to these curve estimates where available. For the Salmon Falls Creek watershed, 23 BURP sites exist, but bankfull width data from those sites represent only spot data (e.g., only three measured widths in a reach just several hundred meters long) that are not always representative of the stream as a whole.

In general, DEQ found BURP bankfull width data to be slightly narrower than natural bankfull width estimates from the Upper Snake Basin curve and chose not to make natural widths any smaller than those estimates. The natural bankfull width estimates are generally more representative of the watersheds investigated as the estimates are derived from watershed scale measurements of area, basin slope, and precipitation. Without extensive measured stream width data or sufficient cause to disregard the natural bankfull estimates, the Upper Snake Basin curve provides the most comprehensive and accurate estimates of bankfull width. Natural bankfull width estimates for each stream in this analysis are presented in Appendix C. The load analysis tables contain a natural bankfull width and an existing bankfull width for every stream segment in the analysis based on the bankfull width results presented in Appendix C. Existing widths and natural widths are the same in load tables when there are no data to support them differing.

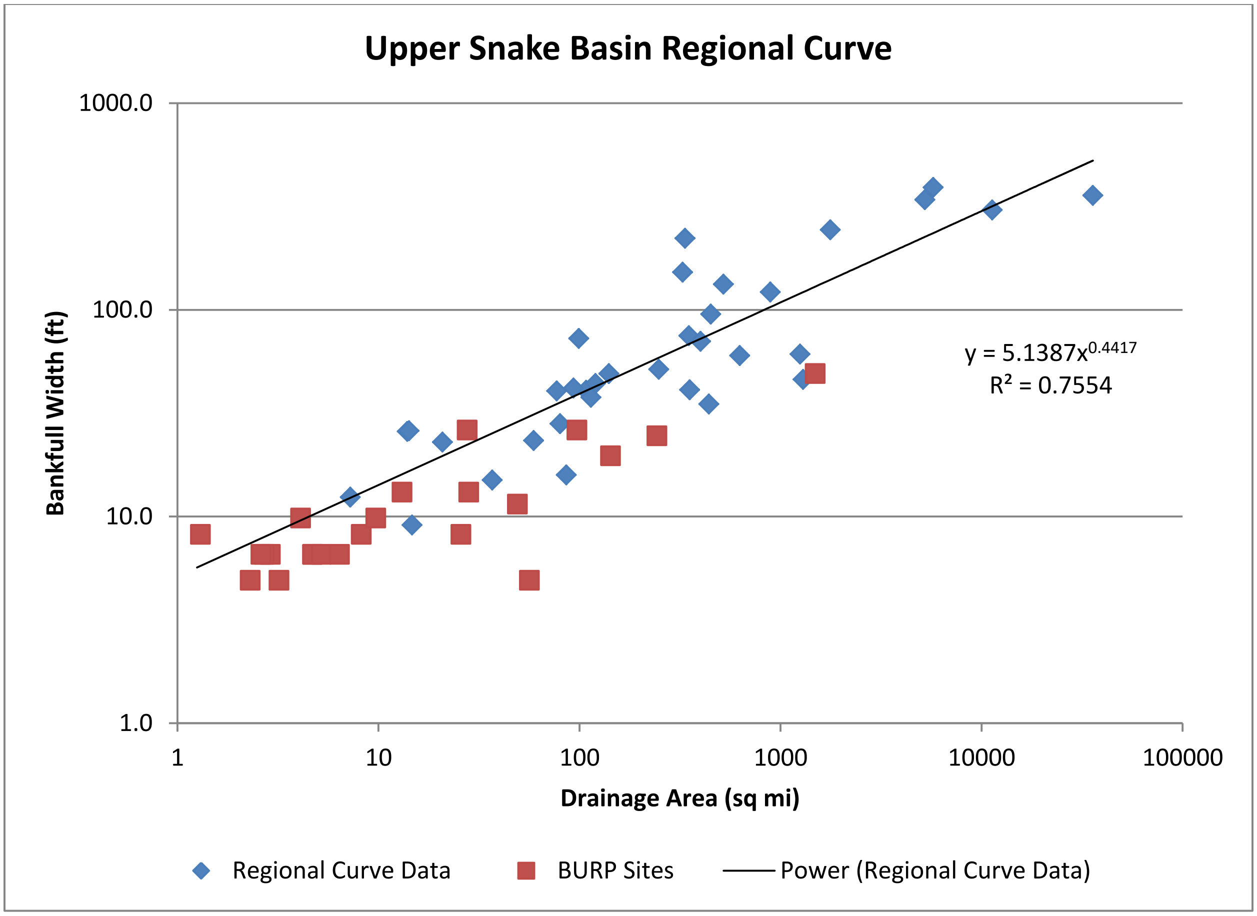

Figure 5. Bankfull width as a function of drainage area.

5.1.3 Design Conditions

The Salmon Falls Creek subbasin is found in two distinct ecoregions. The subbasin occupies portions of the Snake River Plain below the Salmon Falls Creek and Devil Creek confluence (McGrath, et al., 2001). The portions of the subbasin found in the Snake River Plain are typified by arid soils with sagebrush and grass vegetation communities. The larger portion of the subbasin is found in the Northern Basin and Range ecoregion. Within this ecoregion, the subbasin is found in the semi-arid uplands, the high-elevation forests and shrublands, but is primarily comprised of lands within the dissected high lava plateau (McGrath, et al., 2001). The dissected high lava plateau is made up of sagebrush grasslands and scattered woodland growing on rocky uplands. Areas of high water quality and native fish populations may occur in isolated canyons.

Rainbow Trout are the predominant fish species found throughout the streams of the Salmon Falls Creek subbasin (IDFG, 2019). Cold water aquatic life and salmonid spawning are designated uses in the mainstem Salmon Falls Creek. Wild populations of rainbow trout are known to occur in other drainages of the Salmon Falls Creek subbasin with populations of cutthroat trout and brook trout found in the Big Creek drainage (IDFG, 2019). BURP data collected since 2015 indicates that salmonid spawning, particularly rainbow trout, has been occurring in the Salmon Falls Creek, Little House Creek, Cedar Creek, North Fork Salmon Falls Creek, and Big Creek drainages. Protections associated with the designated and existing uses of salmonid spawning throughout the subbasin should be extended to all waters addressed with a TMDL in this document. In addition to the cold water aquatic life standard applicable throughout the year, special protections applicable during salmonid spawning seasons would also be warranted. June 21 through September 21 is considered a period of interest for gaging the frequency of temperature exceedances in relation to the cold water aquatic life temperature standard. This time period accounts for the natural seasonal progression of water temperatures from cooler temperatures in the spring to peak water temperatures in the middle of summer returning to cooler temperatures in the early fall (Essig, 2007). The period of interest for salmonid spawning is the entire spawning and incubation period at a given site. This includes two weeks for spawning and an additional month for egg incubation. The frequency of exceedance calculations of the salmonid spawning standard is based on the particular site and species present (Essig, 2007). Rainbow and cutthroat trout are spring spawning species (DEQ, 2016) and the spring salmonid spawning criteria as detailed in Appendix B would be applicable for the March 15 to July 15 time period. Exceedances are most commonly found during these periods of interest, but also occur outside the periods of interest. These exceedances are not counted in the exceedance calculation, sites with exceedances outside the period of interest are more likely to have exceedances within the period of interest. In that instance, it is also probable that the number of temperature criteria violations within the period of interest will be greater than the 10% criteria exceedance policy (DEQ, 2016). The inclusion of criteria violations outside of the period of interest is more or less inconsequential in terms of determining if an AU is impaired or not.

5.1.4 Shade Curve Selection

To determine PNV shade targets for the Salmon Falls Creek subbasin, DEQ examined effective shade curves based on data from Shumar and De Varona (2009) (Appendix C). These curves were produced using vegetation community modeling of Idaho plant communities within the Salmon Falls Creek subbasin. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. For the Salmon Falls Creek subbasin, curves for the most similar vegetation type were selected for shade target determinations.

Table 7. Shade target curves used in analysis.

Idaho Forest Types	Idaho Non-Forest Types
Salmon Falls Tree and Shrub	Coyote Willow
	Grass
	Mountain Mahogany
	Sagebrush/Grass
	Salmon Falls Shrub

Many different willow species can be found in upper elevations throughout the Salmon Falls Creek subbasin, but lower elevations are dominated by populations of coyote willow. Information gathered by the Bureau of Land Management (BLM) in their Proper Functioning

Condition assessments of riparian areas indicate that various species may be present in many of the streams analyzed as part of this TMDL effort (Scott McLean, email communication January 2020). Also, literature suggests that willow species may overlap in elevational ranges and distribution (Brunsfield & Johnson, 1985; Dorn & Dorn, 1997; Hoag, Tilley, Darris, & Pendergrass, 2008). Since the willow communities are not known to be mapped to the scale necessary for this analysis, willow species were grouped and an average of the key shade producing parameters were used where a shrub community or shrub associated community was identified. Key shade producing parameters (e.g., tree height, percent canopy cover, vegetative overhang) are used to calculate stream shade based on stream width in the PNV analysis. Similar accommodations were used in the Salmon Falls Tree and Shrub as well as in the Salmon Falls Meadow shade curves. Shade curves used to determine targeted shade values are presented in Figure C19 through Figure C24 in Appendix C.

5.2 Load Capacity

The load capacity for a stream under PNV is essentially the solar loading allowed under the shade targets specified for the segments within that stream. These loads are determined by multiplying the solar load measured by a flat-plate collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e., the percent open or 100% minus percent shade). In other words, if a shade target is 60% (or 0.6), the solar load hitting the stream under that target is 40% of the load hitting the flat-plate collector under full sun. The target solar load for each segment identified is then summed to determine the target solar load for the entire AU. The target solar load can be summarized with the following equation:

$$\sum seg = seg_1 + seg_2 + seg_3 + \cdots + seg_n$$

Where:

seg = $NREL\ Collector\ kWh/m^2/day \times\ (1\ - Target\ Shade\ Percentage)$

We obtained hybrid solar load data from flat-plate collectors at the NREL weather stations in Boise and Pocatello. The solar load data used in this TMDL analysis are spring/summer averages (i.e., an average load for the 6-month period from April through September). As such, load capacity calculations are also based on this 6-month period, which coincides with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and fall spawning is occurring. During this period, temperatures may affect beneficial uses such as spring and fall salmonid spawning and cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. However, solar gains can begin early in the spring and affect not only the highest temperatures reached later in the summer but also salmonid spawning temperatures in spring and fall.

Table C3 through Table C26 and Figure C26, Figure C29, and Figure C32 show the PNV shade targets. The tables also show corresponding target summer loads (in kilowatt-hours per square meter per day [$kWh/m^2/day$] and kWh/day) that serve as the load capacities for the streams. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table. Because load calculations involve stream segment area calculations, the segment's channel width, which typically only has one or two significant figures, dictates the level of significance of the corresponding loads. One significant figure in the resulting load can create rounding errors when existing and target loads are subtracted. The totals row of each load table represents total loads with two significant figures in an attempt to reduce apparent rounding errors.

The AU with the largest target load (i.e., load capacity) are the sixth order segments of Salmon Falls Creek made up AU ID17040213SK001_06 and AU ID17040213SK003_06, which cover the stream from the Salmon Falls dam to the Snake River. Each of these AUs have target solar loads of 650,000 kWh/day (Table C3 and Table C12). The smallest target load was in the Hot Creek AU ID17040213SK012_04 with 3,000 kWh/day (Table C19). Table 8 presents the target solar loads for AUs analyzed as part of this TMDL effort. Table 8 also includes excess solar load values and percent solar load reduction that would be required for an AU to meet its solar load targets.

Table 8. Salmon Falls Creek subbasin target solar loads.

Water Body	Assessment Unit Number	Total Target Load	Excess Load (% Reduction)
		(kWh/day)	
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	650,000	380,000 (38%)
Devil Creek	ID17040213SK002_03	260,000	120,000 (32%)
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	650,000	170,000 (20%)
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	68,000	180,000 (72%)
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	490,000	110,000 (18%)
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	89,000	92,000 (48%)
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	100,000	48,000 (32%)
China, Browns, Corral, Player Creeks	ID17040213SK008_02	160,000	120,000 (43%)
China Creek	ID17040213SK008_03	34,000	64,000 (66%)
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	530,000	350,000 (40%)
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_02	11,000	75,000 (93%)
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	14,000	24,000 (63%)
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	560,000	410,000 (42%)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	47,000	9,700 (17%)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	74,000	0 (0%)
Hot Creek	ID17040213SK012_03A	230,000	0 (0%)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	3,000	3,000 (50%)
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	490,000	320,000 (40%)
Big Creek - source to mouth	ID17040213SK014_02	90,000	190,000 (66%)

Big Creek - source to mouth	ID17040213SK014_03	99,000	150,000 (60%)
Cottonwood Creek - source to mouth	ID17040213SK015_02	140,000	360,000 (73%)
Cottonwood Creek - source to mouth	ID17040213SK015_03	61,000	89,000 (59%)
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	130,000	150,000 (56%)
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	500,000	270,000 (36%)

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" (40 CFR 130.2(g)). The existing solar load for each segment identified is then summed to determine the existing solar load for the entire AU. The existing solar load can be summarized with the following equation:

$$\sum seg = seg_1 + seg_2 + seg_3 + \cdots + seg_n$$

Where:

seg = $NREL\ Collector\ kWh/m^2/day \times\ (1\ - Existing\ Shade\ Percentage)$

Existing loads in this temperature TMDL come from estimates of existing shade determined from aerial photo interpretations (Figure C25, Figure C28, and Figure C31). There are currently no permitted point sources in the affected AUs that have the potential to add excess heat to the analyzed waters. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on flat-plate collectors at the NREL weather stations. Existing shade data are presented in Table C3 through Table C26. Like target loads, existing loads in Table C3 through Table C26 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day). Existing loads in kWh/day are also summed for the entire stream or portion of stream examined in a single load analysis table. The difference between target and existing load is also summed for the entire table. Should existing load exceed target load, this difference becomes the excess load (i.e., lack of shade) to be discussed next in the load allocation section and as depicted in the lack-of-shade figures (Figure C27, Figure C30, and Figure C33).

The AU with the largest existing load was Salmon Falls Creek - Devil Creek to mouth (AU ID17040213SK001_06) with 1,000,000 kWh/day (Table C3). The smallest existing load was in the Hot Creek - Idaho/Nevada border to mouth (AU ID17040213SK012_04) with 6,000 kWh/day (Table C19). Table 9 presents the existing solar loads for all assessment units analyzed as part of this TMDL effort. The average lack of shade figures presented in Table 9 represents approximately how much shade is lacking at each stream segment for the entire AU.

An AU with an average lack of shade value of -30% could be considered as generally being three shade classes from meeting shade targets. Average lack of shade values greater than -10% are functioning within the margin of safety for the method. Average lack of shade values greater than -20% could be considered near target. Acceptable error rates within the techniques used to measure, estimate, and calculate solar loads can account for up to another shade class worth of solar loading.

Table 9. Salmon Falls Creek subbasin existing solar loads

Water Body	Assessment Unit Number	Total Existing Load (kWh/day)	Average Lack of Shade (%)
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	1,000,000	-30%
Devil Creek	ID17040213SK002_03	370,000	-22%
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	830,000	-12%
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	250,000	-43%
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	440,000	-19%
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_04	170,000	-6%
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	190,000	-42%
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	150,000	-22%
China, Browns, Corral, Player Creeks	ID17040213SK008_02	280,000	-36%
China Creek	ID17040213SK008_03	97,000	-40%
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	880,000	-40%
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_02	81,000	-49%
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	38,000	-53%
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	970,000	-40%
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	57,000	-30%
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	73,000	0%

Hot Creek	ID17040213SK012_03A	220,000	0%
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	6,000	-51%
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	810,000	-33%
Big Creek - source to mouth	ID17040213SK014_02	290,000	-48%
Big Creek - source to mouth	ID17040213SK014_03	250,000	-40%
Cottonwood Creek - source to mouth	ID17040213SK015_02	490,000	-53%
Cottonwood Creek - source to mouth	ID17040213SK015_03	150,000	-50%
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	270,000	-38%
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	760,000	-29%

5.4 Load Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, in order to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream segment specific and dependent upon the target load for a given segment. Table C3 through Table C26 show the target shade and corresponding target summer load. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent upon background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 10 shows the total existing, target, and excess loads and the average lack of shade for each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths. Table 10 lists the AUs in order of their excess loads, from highest to lowest. Therefore, large AUs tend to be listed first and small AUs last.

Although this TMDL analysis focuses on total solar loads, it is important to note that differences between existing and target shade, as depicted in the shade deficit figures (Figure C27, Figure C30, Figure C33 in Appendix C), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream segment. This value is derived from subtracting target shade from existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The average lack of shade derived from the last column in each load analysis table is listed in Table 10 and provides a general level of comparison among streams.

Table 10. Total solar loads and average lack of shade for all waters.

Water Body	Assessment Unit Number	Total Target Load	Total Existing Load	Excess Load (% Reduction)	Average Lack of Shade (%)
		(kWh/day)			
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	650,000	1,000,000	380,000 (38%)	-30%
Devil Creek	ID17040213SK002_03	260,000	370,000	120,000 (323%)	-22%
Devil Creek - 4th order segment to mouth	ID17040213SK002_04	Intermittent system. Shade analysis not completed.			
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	650,000	830,000	170,000 (20%)	-12%
01 & 02 tribs Cedar Creek Reservoir	ID17040213SK004_02	Intermittent system. Shade analysis not completed.			
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	68,000	250,000	180,000 (72%)	-43%
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	360,000	440,000	74,000 (17%)	-19%
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_04	130,000	170,000	39,000 (23%)	-6%
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	89,000	190,000	92,000 (48%)	-42%
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	100,000	150,000	48,000 (32%)	-22%
China, Browns, Corral, Player Creeks	ID17040213SK008_02	160,000	280,000	120,000 (43%)	-36%
China Creek	ID17040213SK008_03	34,000	97,000	64,000 (66%)	-40%
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	530,000	880,000	350,000 (40%)	-40%
North Fork Salmon Falls Creek-source to	ID17040213SK010_02	11,000	81,000	75,000 (93%)	-49%

Idaho/Nevada border					
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	14,000	38,000	24,000 (63%)	-53%
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	560,000	970,000	410,000 (42%)	-40%
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	47,000	57,000	9,700 (17%)	-30%
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	74,000	73,000	0 (0%)	0%
Hot Creek	ID17040213SK012_03A	230,000	220,000	0 (0%)	0%
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	3,000	6,000	3,000 (50%)	-51%
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	490,000	810,000	320,000 (40%)	-33%
Big Creek - source to mouth	ID17040213SK014_02	90,000	290,000	190,000 (66%)	-48%
Big Creek - source to mouth	ID17040213SK014_03	99,000	250,000	150,000 (60%)	-40%
Cottonwood Creek - source to mouth	ID17040213SK015_02	140,000	490,000	360,000 (73%)	-53%
Cottonwood Creek - source to mouth	ID17040213SK015_03	61,000	150,000	89,000 (59%)	-50%
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	130,000	270,000	150,000 (56%)	-38%
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	500,000	760,000	270,000 (36%)	-29%

Note: Load data are rounded to two significant figures, which may present rounding errors.

Two assessment units in the Hot Creek drainage were meeting shade targets. Shade assessments, completed based on the vegetation communities identified from aerial imagery, indicated that there is currently no excess solar load within these AUs. These AUs are dominated by sagebrush/grass communities and shade targets in these community types are generally much lower than shrub or tree-dominated communities. Other AUs near shade targets include higher order segments of House Creek, Salmon Falls Creek, and Devils Creek. These AUs generally hold wider stream segments that drive shade targets lower even if the identified riparian vegetation is dominated by shrubs. Salmon Falls Creek and Devils Creek are predominantly comprised of coyote willows, which are shorter and do not have as wide of a canopy as other willow species. Larger streams dominated by shorter vegetation communities were closer to meeting shade targets. Small streams with taller riparian plants were furthest from meeting shade targets.

First and second order AUs in the Salmon Falls Creek subbasin require the largest shade deficit reductions. Streams in these AUs are narrower and support riparian communities made up of taller, wider shrubs and trees. In addition, there are usually more stream miles of small order streams, which have a greater surface area with the potential to capture more solar radiation. The largest load reduction requirements were observed in the first and second order segment of North Fork Salmon Creek, at 93% reduction. Other AUs that require large load reductions include first and second orders of Cottonwood Creek at 73% and the first and second order segments of House Creek at 72%.

A certain amount of excess load is potentially created by the existing shade/target shade difference inherent in the loading analysis. Because existing shade is reported as a 10% shade class and target shade a unique integer between 0 and 100%, there is usually a difference between the two. For example, say a particular stream segment has a target shade of 86% based on its vegetation type and natural bankfull width. If existing shade on that segment were at target level, it would be recorded as 80% in the loading analysis because it falls into the 80% existing shade class. There is an automatic difference of 6%, which could be attributed to the margin of safety.

5.4.1 Water Diversion

Stream temperature may be affected by diversions of water for water rights purposes. Diversion of flow reduces the amount of water exposed to a given level of solar radiation in the stream channel, which can result in increased water temperature in that channel. Loss of flow in the channel also affects the ability of the near-stream environment to support shade-producing vegetation, resulting in an increase in solar load to the channel.

Although these water temperature effects may occur, nothing in this TMDL supersedes any water appropriation in the affected watershed. Section 101(g), the Wallop Amendment, was added to the CWA as part of the 1977 amendments to address water rights. It reads as follows:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

Additionally, Idaho water quality standards indicate the following:

> The adoption of water quality standards and the enforcement of such standards is not intended to…interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure… (IDAPA 58.01.02.050.01)

In this TMDL, we have not quantified what impact, if any, diversions are having on stream temperature. Water diversions are allowed for in state statute, and it is possible for a water body to be 100% allocated. Diversions notwithstanding, reaching shade targets as discussed in the TMDL will protect what water remains in the channel and allow the stream to meet water quality standards for temperature. This TMDL will lead to cooler water by achieving shade that would be expected under natural conditions and water temperatures resulting from that shade. DEQ encourages local landowners and holders of water rights to voluntarily do whatever they can to help instream flow for the purpose of keeping channel water cooler for aquatic life.

5.4.2 Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially background conditions, loads (shade levels) are allocated to lands adjacent to these streams at natural background levels. Because shade levels are established at natural background or system potential levels, it is unrealistic to set shade targets at higher, or more conservative, levels. Additionally, existing shade levels are reduced to the next lower 10% shade class, which likely underestimates actual shade in the loading analysis. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

5.4.3 Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the 6-month period from April through September. This time period is when the combination of increasing air and water temperatures coincide with increasing solar inputs and vegetative shade. The critical time periods are April through June when spring salmonid spawning occurs, July and August when maximum temperatures may exceed cold water aquatic life criteria, and September when fall salmonid spawning is most likely to be affected by higher temperatures. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle.

5.4.4 Reasonable Assurance

Clean Water Act §319 requires each state to develop and submit a nonpoint source management plan. The *Idaho Nonpoint Source Management Plan* was approved by EPA in March 2015 (DEQ 2015). The plan identifies programs to achieve implementation of nonpoint source BMPs, includes a schedule for program milestones, outlines key agencies and agency roles, is certified by the state attorney general to ensure that adequate authorities exist to implement the plan, and identifies available funding sources.

Idaho’s nonpoint source management program describes many of the voluntary and regulatory approaches the state will take to abate nonpoint pollution sources. One of the prominent programs described in the plan is the provision for public involvement, including basin advisory groups (BAGs) and WAGs. The Mid Snake WAG is the designated WAG for the Salmon Falls Creek subbasin.

The Idaho water quality standards refer to existing authorities to control nonpoint pollution sources. Some of these authorities and responsible agencies are listed in Table 11.

Table 11. State of Idaho's regulatory authority for nonpoint pollution sources.

Authority	Water Quality Standard	Responsible Agency
Rules Pertaining to the Idaho Forest Practices Act (IDAPA 20.02.01)	58.01.02.350.03(a)	Idaho Department of Lands
Solid Waste Management Rules and Standards (IDAPA 58.01.06)	58.01.02.350.03(b)	Idaho Department of Environmental Quality
Individual/Subsurface Sewage Disposal Rules (IDAPA 58.01.03)	58.01.02.350.03(c)	Idaho Department of Environmental Quality
Stream channel Alteration Rules (IDAPA 37.03.07)	58.01.02.350.03(d)	Idaho Department of Water Resources
Rathdrum Prairie Sewage Disposal Regulations (Panhandle District Health Department)	58.01.02.350.03(e)	Idaho Department of Environmental Quality/Panhandle District Health Department
Rules Governing Exploration, Surface Mining and Closure of Cyanidation Facilities (IDAPA 20.03.02)	58.01.02.350.03(f)	Idaho Department of Lands
Dredge and Placer Mining Operations in Idaho (IDAPA 20.03.01)	58.01.02.350.03(g)	Idaho Department of Lands
Rules Governing Dairy Waste (IDAPA 02.04.14)	58.01.02.350.03(h)	Idaho State Department of Agriculture

Idaho uses a voluntary approach to address agricultural nonpoint sources; however, regulatory authority is found in the water quality standards (IDAPA 58.01.02.350.01–03). IDAPA 58.01.02.055.07 refers to the Idaho Agricultural Pollution Abatement Plan (Ag Plan) (SCC and DEQ 2003), which provides direction to the agricultural community regarding approved BMPs. A portion of the Ag Plan outlines responsible agencies or elected groups (soil conservation districts) that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, the Ag Plan assigns the local soil conservation districts to assist landowners/operators with developing and implementing BMPs to abate nonpoint source pollution associated with land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek injunctive relief for those situations determined to be an imminent and substantial danger to public health or the environment (IDAPA 58.01.02.350.02(a)).

The Idaho water quality standards and wastewater treatment requirements specify that if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary, the state may seek injunctive or other judicial relief against the operator of a nonpoint source activity in accordance with the DEQ director's authority provided in Idaho Code §39-108 (IDAPA 58.01.02.350). The water quality standards list designated agencies responsible for reviewing and revising nonpoint source BMPs:

- Idaho Department of Lands for timber harvest, oil and gas exploration and development, and mining

- Idaho Soil and Water Conservation Commission for grazing and agricultural activities
- Idaho Transportation Department for public road construction
- Idaho State Department of Agriculture for aquaculture
- DEQ for all other activities

5.4.5 Construction Stormwater Allocations

There are three known National Pollutant Discharge Elimination System (NPDES) permitted point sources in the affected watersheds; however, two of the facilities have terminated permits, and the remaining facility is associated with a construction project and is not given a wasteload allocation. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the IPDES program and implement the appropriate BMPs. No wasteload allocations factor into the TMDLs created in this document for the Salmon Falls Creek subbasin. Should a point source be proposed that would have thermal consequences on these waters, background provisions in Idaho water quality standards addressing such discharges (IDAPA 58.01.02.200.09; IDAPA 58.01.02.401.01) should be involved (Appendix B).

Stormwater runoff is water from rain or snowmelt that does not immediately infiltrate into the ground and flows over or through natural or man-made storage or conveyance systems. When undeveloped areas are converted to land uses with impervious surfaces—such as buildings, parking lots, and roads—the natural hydrology of the land is altered and can result in increased surface runoff rates, volumes, and pollutant loads. Certain types of stormwater runoff are considered point source discharges for Clean Water Act purposes, including stormwater that is associated with municipal separate storm sewer systems (MS4s), industrial stormwater covered under the Multi-Sector General Permit (MSGP), and construction stormwater covered under the Construction General Permit (CGP). For more information about these permits and managing stormwater, see Appendix D.

5.4.6 Reserve for Growth

There is no nonpoint reserve for growth in a temperature TMDL. The allocations are based on meeting a natural background riparian canopy condition. However, there may be the need for point source reserve for growth if there are any future discharges planned.

A growth reserve has not been included in this TMDL. The load capacity has been allocated to the existing sources in the watershed. Any new sources will need to obtain an allocation from the existing load allocation.

5.5 Protection of Downstream Waters

Consistent with IDAPA 58.01.02.054.04, “there is no impairment of beneficial uses or violations of water quality standards where natural conditions exceed applicable water quality criteria.” This TMDL’s load capacity estimates and load allocations are based on the concept of PNV. The goal of PNV TMDLs is to attain shade conditions equivalent to natural conditions and achieve a temperature regime expected under natural background conditions. Since this TMDL does not estimate natural background temperatures, but uses shade as a surrogate, no numeric temperature target is established. Since natural background standards only apply “when natural background conditions exceed any applicable water quality criteria” (IDAPA 58.01.02.200.09), if stream temperatures are below numeric temperature criteria when natural conditions are achieved (i.e., TMDL is fully implemented), natural background standards would not apply; however, if stream temperatures do not exceed numeric criteria when PNV is achieved, there is no longer an impairment of beneficial uses due to temperature.

Idaho’s water quality standards require that all waters “shall maintain a level of water quality at their pour point into downstream waters that provides for the attainment and maintenance of the water quality standards of those downstream waters, including waters of another state or tribe” (IDAPA 58.01.02.070.08). The TMDLs in the document are developed to achieve stream temperature equivalent to natural background conditions. If stream temperatures exceed numeric temperature criteria when PNV targets are achieved and there are no other anthropogenic sources of heat load, the stream temperature is equivalent to natural background temperature or natural conditions, consistent with IDAPA 58.01.02.09.209 and NAC 445A.121. The allocations in this TMDL are developed to achieve natural background temperatures which are considered to be protective of beneficial uses and would not contribute to downstream temperature impairments.
AUs analyzed in this TMDL are tributary to AUs analyzed for the same impairment within this TMDL.

Table 2 identifies waterbodies and beneficial uses downstream of waterbodies addressed in this TMDL, with the exception of a portion of Shoshone Creek between the Idaho/Nevada Border and its confluence with Salmon Falls Creek and the downstream terminus of the subbasin. The waters of the Salmon Falls Creek subbasin empty to the Snake River in the Box Canyon to Lower Salmon Falls segment of the river (AU ID17040212SK005_07).

AU 17040213SK011_04, Shoshone Creek – Hot Creek to Idaho/Nevada Border flows into Nevada approximately six miles east of Jackpot, Nevada. Shoshone Creek directly downstream of Idaho's AU17040213SK001_04 is known as Shoshone Creek from the Nevada-Idaho state line to its confluence with Salmon Falls Creek or NV03-SR-03_00. Shoshone Creek directly downstream of Idaho's border designated for aquatic life use (NAC445A.122 and NAC 445A.1342). Shoshone Creek's (NV03-SR03_00) aquatic life use is listed as impaired by temperature in Nevada's 2016–2018 Integrated Report (NDEP 2020). Nevada's numeric temperature criteria to protect the aquatic life use in Shoshone Creek is a single sample value of less than 21 °C from May through October and a single sample value of less than 13 °C from November through April (NAC 445.1342). Additionally, Nevada's water quality standards state "the specified standards are not considered violated when the natural conditions of the receiving water are outside the established limits, including periods of extreme high or low flow (NAC 445A.121)."

At the lower terminus of the watershed, Salmon Falls Creek flows into the Snake River – Box Canyon to Lower Salmon Falls (AU17040212SK005_07). Beneficial uses in that AU of the Snake River include the designated uses of cold water aquatic life, salmonid spawning, and primary contact recreation. Numeric criteria can be found in Appendix B. This assessment unit is in Category 4a with approved sediment and total phosphorus TMDLs and Category 4c for flow alterations (DEQ 2016).

The allocations in this TMDL are developed to achieve natural background temperatures considered to be protective of beneficial uses and would not contribute to downstream temperature impairments to the Snake River or Nevada's Shoshone Creek. While Nevada has prioritized Shoshone Creek as a low priority for TMDL development (NDEP 2020), DEQ remains committed to reevaluating the Shoshone Creek PNV TMDLs in future five-year reviews.

5.6 Implementation Strategies

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals. Reasonable assurance (addressed in section 5.4.4) for the TMDL to meet water quality standards is based on the implementation strategy.

Implementation strategies for TMDLs produced using PNV-based shade and solar loads should incorporate the load analysis tables presented in this TMDL (Table C3 through Table C26). These tables need to be updated, first to field verify the remaining existing shade levels and second to monitor progress toward achieving reductions and TMDL goals. Using the Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the load analysis tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field verify the TMDL and mark progress toward achieving desired load reductions.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals. Reasonable assurance (addressed in section 5.4.4) for the TMDL to meet water quality standards is based on the implementation strategy. There may be a variety of reasons that individual stream segments do not meet shade targets, including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) and/or historic land-use activities (e.g., logging, grazing, and mining). It is important that existing shade for each stream segment be field verified to determine if shade differences are real and result from activities that are controllable. Information within this TMDL (maps and load analysis tables) should be used to guide and prioritize implementation investigations. The information in this TMDL may need further adjustment to reflect new information and conditions in the future.

5.6.1 Time Frame

Implementing the temperature TMDL relies on riparian area management practices that provide a mature canopy cover to shade the stream and prevent excess solar loading. Because implementation is dependent on mature riparian communities to substantially improve stream temperatures, DEQ believes 10–20 years may be a reasonable amount time for achieving water quality standards. Shade targets will not be achieved all at once. Given their smaller bankfull widths, smaller streams may reach targets sooner than larger streams.

5.6.2 Approach

Funding provided under Clean Water Act §319 and other funds will be used to encourage voluntary projects to reduce nonpoint source pollution.

5.6.3 Responsible Parties

DEQ and the designated management agencies in Idaho have primary responsibility for overseeing implementation in cooperation with landowners and managers. In Idaho, these agencies and their federal and state partners are charged by the Clean Water Act to lend available technical assistance and other appropriate support to local efforts for water quality improvements. Designated state agencies are responsible for assisting with preparation of specific implementation plans, particularly for resources they have regulatory authority or programmatic responsibilities:

- Idaho Department of Lands for timber harvest, oil and gas exploration and development, and mining
- Idaho Soil and Water Conservation Commission for grazing and agricultural activities
- Idaho Transportation Department for public road construction

- Idaho State Department of Agriculture for aquaculture
- DEQ for all other activities

In addition to the designated management agencies, the public—through the WAG and other equivalent organizations or processes—have opportunities to be involved in developing the implementation plan to the maximum extent practical. Public participation will significantly affect public acceptance of the document and the proposed control actions. Stakeholders (e.g., landowners, local governing authorities, taxpayers, industries, land managers) are the most educated regarding the pollutant sources and will be called upon to help identify the most appropriate control actions for each area. Experience has shown that the best and most effective implementation plans are those developed with substantial public cooperation and involvement.

5.6.4 Implementation Monitoring Strategy

The objectives of a monitoring strategy are to demonstrate long-term recovery, better understand natural variability, track project and BMP implementation, and track the effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the reasonable assurance component of the TMDL implementation plan.

Monitoring will provide information on progress toward achieving TMDL allocations and water quality standards and will help in the interim evaluation of progress, including in the development of five-year reviews and future TMDLs.

The implementation plan will be tracked by accounting for the numbers, types, and locations of projects, BMPs, educational activities, or other actions taken to improve or protect water quality. Implementation plan monitoring will include watershed monitoring and BMP monitoring.
Effective shade monitoring can take place on any segment throughout the Salmon Falls Creek subbasin and be compared to existing shade estimates seen in Figure X and described in Table C3 through Table C26. Those areas with the largest disparity between existing and target shade should be monitored with Solar Pathfinders to verify existing shade levels and determine progress toward meeting shade targets. Since many existing shade estimates have not been field verified, they may require adjustment during the implementation process. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade toward target levels. Ten equally spaced Solar Pathfinder measurements averaged together within that segment should suffice to determine new shade levels in the future.

5.6.5 Pollutant Trading

Pollutant trading (also known as water quality trading) is a contractual agreement to exchange pollution reductions between two parties. Pollutant trading is a business-like way of helping to solve water quality problems by focusing on cost-effective, local solutions to problems caused by pollutant discharges to surface waters. Pollutant trading is one of the tools available to meet reductions called for in a TMDL where point and nonpoint sources both exist in a watershed. For additional information, see Appendix E.

6 Conclusions

Effective shade targets were established for 15 water bodies (26 AUs) in the Salmon Falls Creek subbasin, based on the concept of maximum shading under PNV resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation and partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho’s water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table 12.

Table 12. Summary of assessment outcomes.

Water Body	Assessment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to Next Integrated Report	Justification
Salmon Falls Creek - Devil Creek to mouth	ID17040213SK001_06	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Devil Creek	ID17040213SK002_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Devil Creek - 4th order segment to mouth	ID17040213SK002_04	Temperature	No	Remain in Category 4a	Intermittent system; TMDL could not be calculated.
Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek	ID17040213SK003_06	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
01 & 02 tribs Cedar Creek Reservoir	ID17040213SK004_02	Temperature	No	Remain in Category 4a	Intermittent system; TMDL could not be calculated.
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
House Creek - source to Cedar Creek Reservoir	ID17040213SK005_04	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cedar Creek - source to Cedar Creek Reservoir	ID17040213SK006_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
China, Browns, Corral, Player Creeks	ID17040213SK008_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)

China Creek	ID17040213SK008_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek	ID17040213SK009_06	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
North Fork Salmon Falls Creek-source to Idaho/Nevada border	ID17040213SK010_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - Hot Creek to Idaho/Nevada border	ID17040213SK011_04	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek	ID17040213SK012_03A	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Hot Creek - Idaho/Nevada border to mouth	ID17040213SK012_04	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - Cottonwood Creek to Hot Creek	ID17040213SK013_04	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Big Creek - source to mouth	ID17040213SK014_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)

Big Creek - source to mouth	ID17040213SK014_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cottonwood Creek - source to mouth	ID17040213SK015_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Cottonwood Creek - source to mouth	ID17040213SK015_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_02	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)
Shoshone Creek - source to Cottonwood Creek	ID17040213SK016_03	Temperature	Yes	Remain in Category 4a	Excess solar load from lack of shade; (Idaho shade curves)

Few AUs were found to be at or near shade targets. Two AUs in the Hot Creek drainage are currently meeting shade targets and could be candidates for temperature delisting under Idaho’s natural background provisions after further investigation to determine if other human caused factors are present in the drainage. AUs in the middle portion of Shoshone Creek are nearing targeted shade levels and may be reflective of recovering riparian areas in the basin. Average lack of shade throughout the subbasin is generally three to five shade classes away from meeting or being near targeted shade levels.

Target shade levels for individual stream segments should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts.
This document was prepared with input from the public, as described in Appendix F. Following the public comment period, comments and DEQ responses will also be included in this appendix, and a distribution list will be included in Appendix G.

References

Armantrout, N.B., compiler. 1998. *Glossary of Aquatic Habitat Inventory Terminology*. Bethesda, MD: American Fisheries Society.

Brunsfield, S. J., & Johnson, F. D. 1985. *Field Guide to the Willows of East-Central Idaho.* Moscow, ID: University of Idaho, Forest, Wildlife, and Range Experiment Station Bull. No. 39.

CFR (Code of Federal Regulation). 1977. "Guidelines Establishing Test Procedures for the Analysis of Pollutants." 40 CFR 136.

CFR (Code of Federal Regulation). 1983. "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System." 40 CFR 122.

CFR (Code of Federal Regulation). 1983. "Water Quality Standards." 40 CFR 131.

CFR (Code of Federal Regulation). 1995. "Water Quality Planning and Management." 40 CFR 130.

DEQ (Idaho Department of Environmental Quality). 2005. *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties*. Boise, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/wastewater/stormwater*.

DEQ(Idaho Department of Environmental Quality). 2007. *Salmon Falls Creek Subbasin Assessment and Total Maximum Daily Loads.* Boise, ID: Idaho Department of Environmental Quality.

DEQ (Idaho Department of Environmental Quality). 2014. *Idaho's 2012 Integrated Report*. Boise, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/surface-water/monitoring-assessment/integrated-report*.

DEQ (Idaho Department of Environmental Quality). 2016a. *Water Body Assessment Guidance.* 3rd ed. Boise, ID: Department of Environmental Quality.

DEQ (Idaho Department of Environmental Quality). 2016b. *Water Quality Pollutant Trading Guidance*. Boise, ID: DEQ. Available at: *www.deq.idaho.gov/water-quality/surface-water/pollutant-trading*.

DEQ (Idaho Department of Environmental Quality). 2018. *Final 2016 Integrated Report.* Boise, ID: Idaho Department of Environmental Quality.

Dorn, R. D., & Dorn, J. L. (1997). *Rocky Mountain Region Willow Identification Field Guide.* Denver, CO: U.S. Forest Service, Renewable Resources R2-RR-97-01.

EPA (US Environmental Protection Agency). 1996. *Biological Criteria: Technical Guidance for Streams and Small Rivers*. Washington DC: EPA, Office of Water. EPA 822-B-96-001.

Brunsfield, S. J., & Johnson, F. D. (1985). *Field Guide to the Willows of East-Central Idaho.* Moscow, ID: University of Idaho, Forest, Wildlife, and Range Experiment Station Bull. No. 39.

DEQ. (2007). *Salmon Falls Creek Subbasin Assessment and Total Maximum Daily Loads.* Boise, ID: Idaho Department of Environmental Quality.

DEQ. (2016). *Water Body Assessment Guidance, 3rd Edition.* Boise, ID: Idaho Department of Environmental Quality.

DEQ. (2018). *Final 2016 Integrated Report.* Boise, ID: Idaho Department of Environmental Quality.

Dorn, R. D., & Dorn, J. L. (1997). *Rocky Mountain Region Willow Identification Field Guide.* Denver, CO: U.S. Forest Service, Renewable Resources R2-RR-97-01.

EPA. (2019). *2017 National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities.* Environmental Protection Agency.

Essig, D. (2007). *Temperature Frequency fo Exceedance Calculation Procedure, 3rd Revision.* Boise, ID: Idaho Department of Environmental Quality.

Hoag, C., Tilley, D., Darris, D., & Pendergrass, K. (2008). *Field Guide for the Identification and Use of Common Riparian Woody Plants of the Intermountain West and Pacific Northwest Regions.* OR and ID: Natural Resources Conservation Service Plant Material Center.

IDFG. (2019). *Fisheries Management Plan 2019 - 2024.* Boise, USA: Idaho Department of Fish and Game.

McGrath, C. L., Woods, A. J., Omernik, J. M., Bryce, S. A., Edmondson, M., Nesser, J. A., et al. (2001). *Ecoregions of Idaho (color poster with map, descriptive text, summary tables, and photographs).* Reston, Virginia: U.S. Geological Survey (mapscale 1:1,350,000).

Shumar, M. L., & De Varona, J. (2009). *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual.* Boise, ID: Idaho Department of Environmental Quality.

Hoag, C., Tilley, D., Darris, D., & Pendergrass, K. 2008. Field Guide for the Identification and Use of Common Riparian Woody Plants of the Intermountain West and Pacific Northwest Regions. OR and ID: Natural Resources Conservation Service Plant Material Center.

Idaho Code. 2017. “Creation of Watershed Advisory Groups.” Idaho Code 39-3615.

Idaho Code. 2017. “Development and Implementation of Total Maximum Daily Load or Equivalent Processes.” Idaho Code 39-3611.

IDAPA. 2017. “Idaho Water Quality Standards.” Idaho Administrative Code. IDAPA 58.01.02.

IDFG (Idaho Department of Fish and Game). 2019. *Fisheries Management Plan 2019 - 2024.* Boise, USA: Idaho Department of Fish and Game.

IDL (Idaho Department of Lands). 2000. *Forest Practices Cumulative Watershed Effects Process for Idaho*. Boise, ID: IDL.

ISWCC (Idaho Soil and Water Conservation Commission). 2015. *Idaho Agricultural Pollution Abatement Plan*. Boise, ID: Resource Planning Unlimited, Inc.

Küchler, A.U. 1964. “Potential Natural Vegetation of the Conterminous United States.” American Geographical Society Special Publication 36.

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2001. “Ecoregions of Idaho.” Reston, VA: US Geological Survey.

NAC (Nevada Administrative Code). 2018. Chapter 445A – Water Controls. Available at: https://www.leg.state.nv.us/NAC/NAC-445A.html

NDEP (Nevada Department of Environmental Protection). 2020. Nevada 2016-2018 Water Quality Integrated Report. Carson City, NV: NDEP. Available at: https://ndep.nv.gov/uploads/water-wqm-docs/IR2018_FINAL_IR_April_2020.pdf

OWEB (Oregon Watershed Enhancement Board). 2001. “Stream Shade and Canopy Cover Monitoring Methods.” In *Water Quality Monitoring Technical Guide Book*, chap. 14. Salem, OR: OWEB.

Poole, G.C. and C.H. Berman. 2001. “An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation.” *Environmental Management* 27(6):787–802.

Shumar, M.L. and J. De Varona. 2009. *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual*. Boise, ID: Idaho Department of Environmental Quality.

Strahler, A.N. 1957. “Quantitative Analysis of Watershed Geomorphology.” *Transactions American Geophysical Union* 38:913–920.

US Congress. 1972. Clean Water Act (Federal Water Pollution Control Act). 33 USC §1251–1387.

GIS Coverages

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IDWR (Idaho Department of Water Resources). 2008. Idaho Watershed Boundary 5th and 6th Field Delineation Project. Boundaries were created using the "USGS interagency guideline on delineation of watershed and subwatershed hydrologic unit boundaries" standards. <http://www.idwr.idaho.gov /GeographicInfo/Watersheds/default.htm> Finalized December 2, 2008. Boise, ID.

IDWR (Idaho Department of Water Resources). 2009. Subbasins (USGS 1:250,000) Fourth-field hydrologic units.

IDWR (Idaho Department of Water Resources). 2010. Points of diversion. Shapefiles for water rights developed from place of use or centroids for points of diversion. Boise, ID. July 19, 2010.

NAIP (National Agriculture Imagery Program). 2011. Digital ortho quarter quad tiles. Aerial Photography Field Office, Salt Lake City, UT. September 10, 2012.

US Bureau of Land Management. 2010. Surface Management Agency for Idaho. <http://insideidaho.org> Administrative land use boundaries updated twice yearly by the Engineering and Geographic Sciences department, Idaho State Office, U.S. Bureau of Land Management, Boise, ID.

U.S. Geological Survey, 2019, National Hydrography Dataset (ver. USGS National Hydrography Dataset 1:24k Resolution (NHD).

Glossary

§303(d)

Refers to section 303 subsection "d" of the Clean Water Act. Section 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to United States Environmental Protection Agency approval.

Assessment Unit (AU)

A group of similar streams that have similar land use practices, ownership, or land management. However, stream order is the main basis for determining AUs. All the waters of the state are defined using AUs, and because AUs are a subset of water body identification numbers, they tie directly to the water quality standards so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

Beneficial Use

Any of the various uses of water that are recognized in water quality standards, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics.

Beneficial Use Reconnaissance Program (BURP)

A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers.

Exceedance

A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.

Fully Supporting

In compliance with water quality standards and within the range of biological reference conditions for all designated and existing beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Load Allocation (LA)

A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).

Load

The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Load is the product of flow (discharge) and concentration.

Load Capacity (LC)

How much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, a margin of safety, and natural background contributions, it becomes a total maximum daily load.

Margin of Safety (MOS)

An implicit or explicit portion of a water body's load capacity set aside to allow for uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. The margin of safety is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The margin of safety is not allocated to any sources of pollution.

Nonpoint Source

A dispersed source of pollutants generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and nonirrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Assessed (NA)

A concept and an assessment category describing water bodies that have been studied but are missing critical information needed to complete an assessment.

Not Fully Supporting

Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Point Source

A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater plants.

Pollutant

Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Pollution

A very broad concept that encompasses human-caused changes in the environment that alter the functioning of natural processes and produce undesirable environmental and health effects. Pollution includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.

Potential Natural Vegetation (PNV)

A.U. Küchler (1964) defined potential natural vegetation as vegetation that would exist without human interference and if the resulting plant succession were projected to its climax condition while allowing for natural disturbance processes such as fire. Our use of the term reflects Küchler's definition in that riparian vegetation at PNV would produce a system potential level of shade on streams and includes recognition of some level of natural disturbance.

Stream Order

Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher-order streams result from the joining of two streams of the same order.

Total Maximum Daily Load (TMDL)

A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual basis. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Wasteload Allocation (WLA)

The portion of receiving water's load capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

Water Quality Criteria

Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, aquatic habitat, or industrial processes.

Water Quality Standards

State-adopted and United States Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Appendix A. Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for waters of the state. Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses.

Existing Uses

Existing uses under the Clean Water Act are “those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards” (40 CFR 131.3). The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.051.01). Existing uses need to be protected, whether or not the level of water quality to fully support the uses currently exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that supported salmonid spawning since November 28, 1975, but does not now due to other factors, such as blockage of migration, channelization, sedimentation, or excess heat.

Designated Uses

Designated uses under the Clean Water Act are “those uses specified in water quality standards for each water body or segment, whether or not they are being attained” (40 CFR 131.3). Designated uses are simply uses officially recognized by the state. In Idaho, these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Multiple uses often apply to the same water; in this case, water quality must be sufficiently maintained to meet the most sensitive use (designated or existing). Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are described in the Idaho water quality standards (IDAPA 58.01.02.100) and specifically listed by water body in sections 110–160.

Undesignated Surface Waters and Presumed Use Protection

In Idaho, due to a change in scale of cataloging waters in 2000, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations (IDAPA 58.01.02.110–160). The water quality standards have three sections that address nondesignated waters. Sections 101.02 and 101.03 specifically address nondesignated man-made waterways and private waters. Man-made waterways and private waters have no presumed use protections. Man-made waters are protected for the use for which they were constructed unless otherwise designated in the water quality standards. Private waters are not protected for any beneficial uses unless specifically designated in the water quality standards.

All other undesignated waters are addressed by section 101.01. Under this section, absent information on existing uses, DEQ presumes that most Idaho waters will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called presumed uses, DEQ applies the numeric cold water and recreation criteria to undesignated waters. If in addition to presumed uses, an additional existing use (e.g., salmonid spawning) exists, then the additional numeric criteria for salmonid spawning would also apply (e.g., intergravel dissolved oxygen, temperature) because of the requirement to protect water quality for that existing use. However, if some other use that requires less stringent criteria for protection (such as seasonal cold aquatic life) is found to be an existing use, then a use designation (rulemaking) is needed before that use can be applied in lieu of cold water criteria (IDAPA 58.01.02.101.01).

Appendix B. State and Site-Specific Water Quality Standards and Criteria

Table B1. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

Parameter	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning[a]
Water Quality Standards: IDAPA 58.01.02.250–251				
Bacteria				
• Geometric mean	<126 *E. coli*/100 mL[b]	<126 *E. coli*/100 mL	—	—
• Single sample	≤406 *E. coli*/100 mL	≤576 *E. coli*/100 mL	—	—
pH	—	—	Between 6.5 and 9.0	Between 6.5 and 9.5
Dissolved oxygen (DO)	—	—	DO exceeds 6.0 milligrams/liter (mg/L)	**Water Column DO**: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater **Intergravel DO**: DO exceeds 5.0 mg/L for a 1-day minimum and exceeds 6.0 mg/L for a 7-day average
Temperature[c]	—	—	22 °C or less daily maximum; 19 °C or less daily average **Seasonal Cold Water**: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	13 °C or less daily maximum; 9 °C or less daily average **Bull Trout**: Not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9 °C daily average in September and October
Turbidity	—	—	Turbidity shall not exceed background by more than 50 nephelometric turbidity units (NTU) instantaneously or more than 25 NTU for more than 10 consecutive days.	—
Ammonia	—	—	Ammonia not to exceed calculated concentration based on pH and temperature.	—
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Temperature	—	—	—	7-day moving average of 10 °C or less maximum daily temperature for June–September

[a] During spawning and incubation periods for inhabiting species
[b] *Escherichia coli* per 100 milliliters
[c] Temperature exemption: Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the 7-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies by species. For spring-spawning salmonids, the default spawning and incubation period recognized by the Idaho Department of Environmental Quality (DEQ) is generally March 15 to July 15 (DEQ 2016). Fall spawning can occur as early as September 1 and continue with incubation into the following spring up to June 1. As per IDAPA 58.01.02.250.02.f.ii., the following water quality criteria need to be met during that time period:

- 13 °C as a daily maximum water temperature
- 9 °C as a daily average water temperature

For the purposes of a temperature TMDL, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of the highest annual maximum weekly maximum air temperatures) is compared to the daily maximum criterion of 13 °C. The difference between the two water temperatures represents the temperature reduction necessary to achieve compliance with temperature standards.

Natural Background Provisions

For PNV temperature TMDLs, it is assumed that natural temperatures may exceed these criteria during certain time periods. If PNV targets are achieved yet stream temperatures are warmer than these criteria, it is assumed that the stream’s temperature is natural (provided there are no point sources or human-induced ground water sources of heat) and natural background provisions of Idaho water quality standards apply:

> When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401. (IDAPA 58.01.02.200.09)

Section 401 relates to point source wastewater treatment requirements. In this case, if temperature criteria for any aquatic life use are exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3 °C (IDAPA 58.01.02.401.01.c).

Appendix C. Data Sources

Table C1. Data sources for Salmon Falls Creek subbasin assessment.

Data Source	Type of Data	Collection Date
DEQ Twin Falls Regional Office	Solar Pathfinder effective shade and stream width estimates	September 2019
DEQ Technical Services Division	Salmon Falls Creek subbasin shade curves	January 2020
DEQ Technical Services Division	Salmon Falls Creek subbasin solar load tables	January 2020

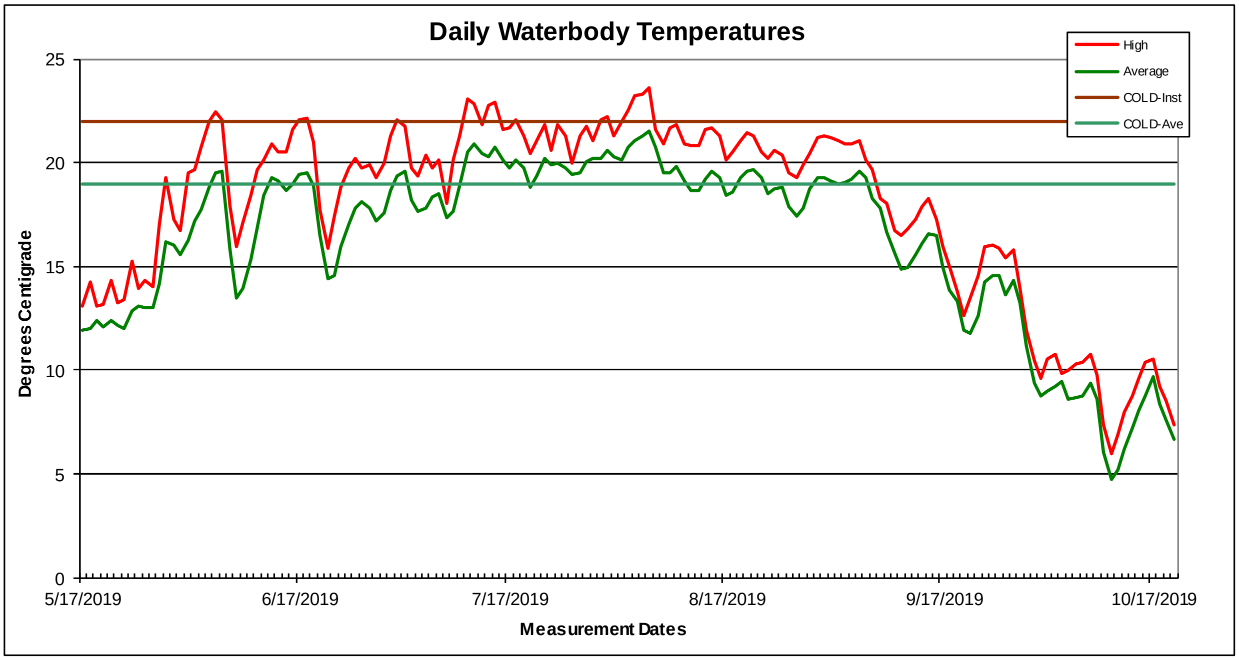
Stream Temperature Data

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Salmon Falls Creek
Data Collection Site: 9935906
Data Period: 5/17/2019 - 10/20/2019

MDMT = 23.6, 06 Aug
MWMT = 22.6, 06 Aug
MDAT = 21.5, 06 Aug
MWAT = 20.8, 07 Aug

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK003_06



Idaho Cold Water Aquatic Life - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	12	13%	
19 °C Average	47	51%	
Days Evaluated & Date Range	93	21-Jun	1-Sep

Idaho Salmonid Spawning - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	60	100%	
9 °C Average Spring	60	100%	
Spring Days Eval'd w/in Dates	60	15-Mar	15-Jul

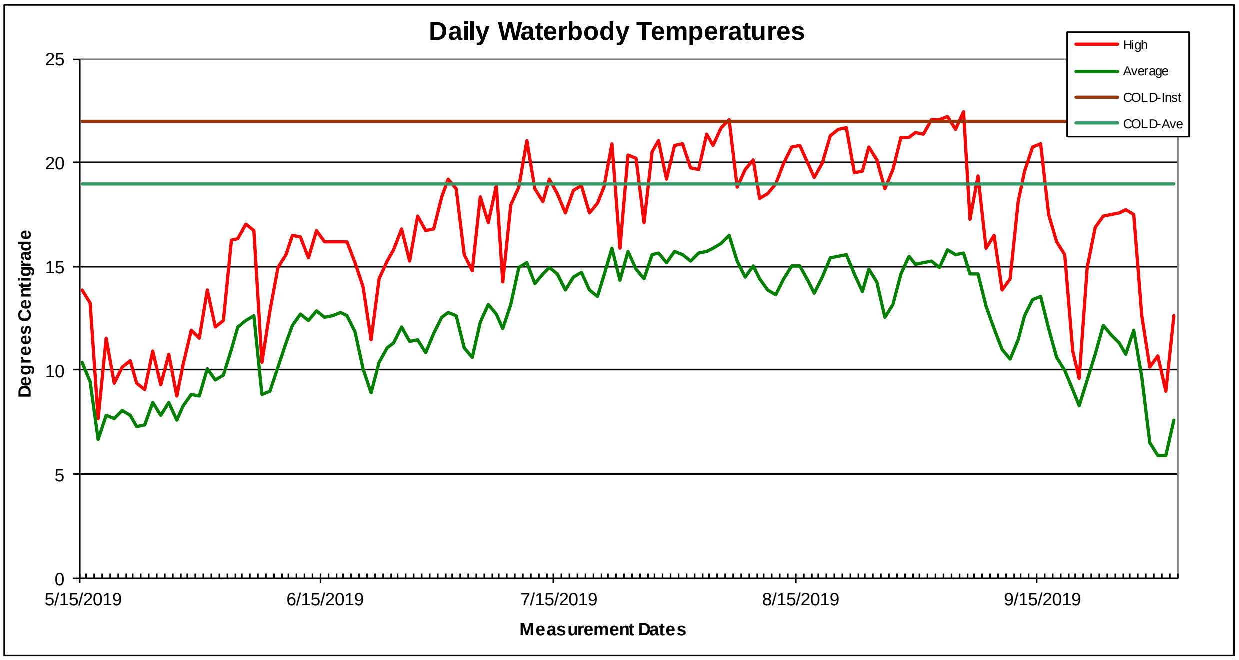
Figure C1. 2019 Temperature data for Salmon Falls Creek in AU ID17040213SK003_06

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Little House Creek
Data Collection Site: 2440772
Data Period: 5/15/2019 - 10/2/2019

MDMT = 22.4, 05 Sep
MWMT = 21.9, 05 Sep
MDAT = 16.5, 06 Aug
MWAT = 15.8, 06 Aug

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK005_02



Idaho Cold Water Aquatic Life - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	5	5%	
19 °C Average	0	0%	
Days Evaluated & Date Range	93	21-Jun	1-Sep

Idaho Salmonid Spawning - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	43	69%	
9 °C Average Spring	45	73%	
Spring Days Eval'd w/in Dates	62	15-Mar	15-Jul

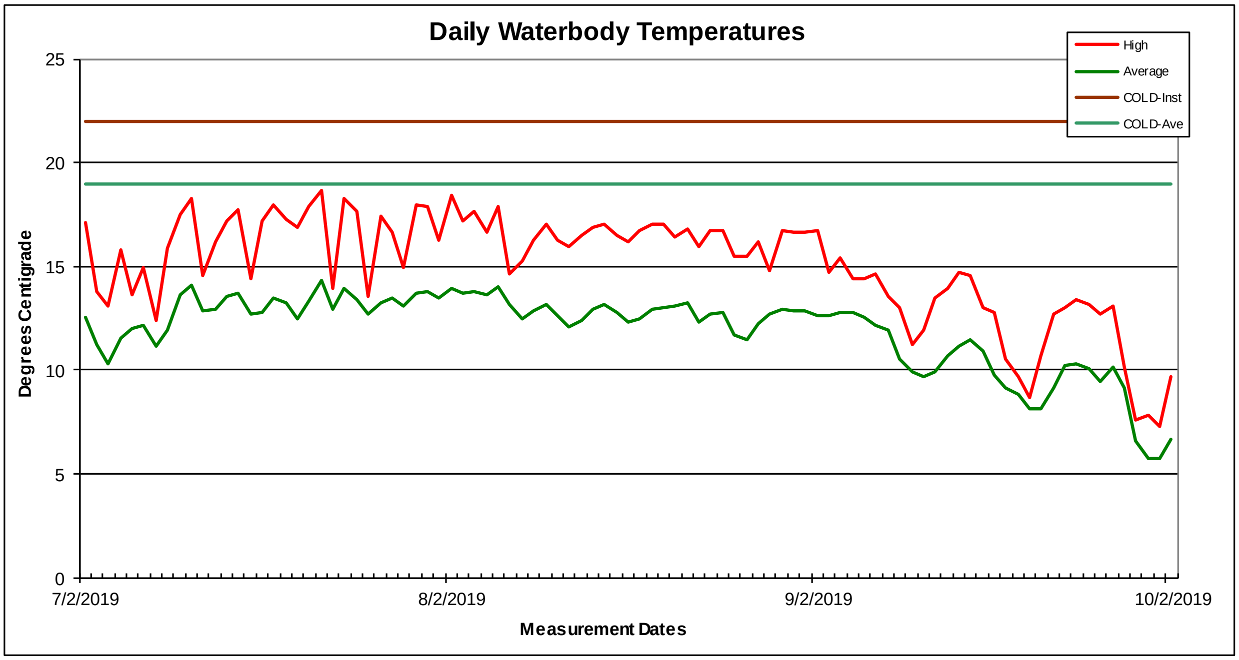
Figure C2. 2019 Temperature data for Little House Creek in AU ID17040213SK005_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Cedar Creek
Data Collection Site: 10724012
Data Period: 7/2/2019 - 10/2/2019

MDMT = 18.6, 22 Jul
MWMT = 17.4, 05 Aug
MDAT = 14.3, 22 Jul
MWAT = 13.7, 06 Aug

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK006_02



Idaho Cold Water Aquatic Life - 2019 **Criteria Exceedance Summary**			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	82	21-Jun	1-Sep

Idaho Salmonid Spawning - 2019 **Criteria Exceedance Summary**			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	13	93%	
9 °C Average Spring	14	100%	
Spring Days Eval'd w/in Dates	14	15-Mar	15-Jul

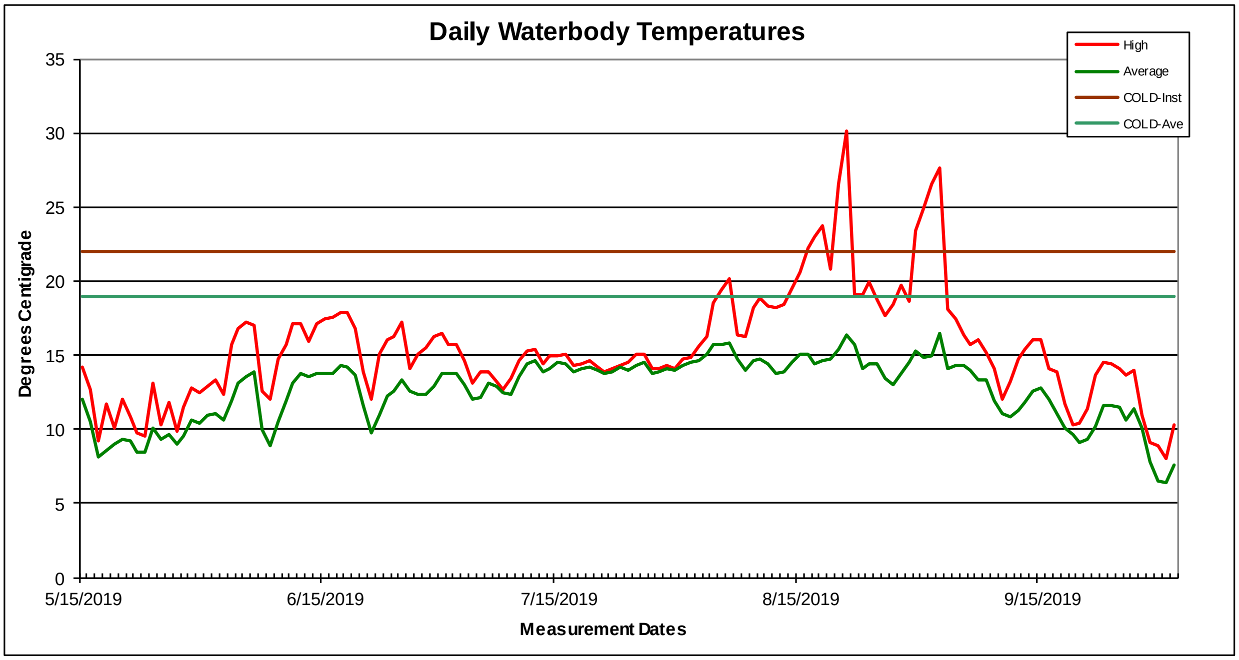
Figure C3. 2019 Temperature data for Cedar Creek in AU ID17040213SK006_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Cedar Creek
Data Collection Site: 9935905
Data Period: 5/15/2019 - 10/2/2019

MDMT = 30.2, 21 Aug
MWMT = 23.9, 21 Aug
MDAT = 16.5, 02 Sep
MWAT = 15.2, 07 Aug

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK006_03



Idaho Cold Water Aquatic Life - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	9	10%	
19 °C Average	0	0%	
Days Evaluated & Date Range	93	21-Jun	1-Sep

Idaho Salmonid Spawning - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	42	68%	
9 °C Average Spring	56	90%	
Spring Days Eval'd w/in Dates	62	15-Mar	15-Jul

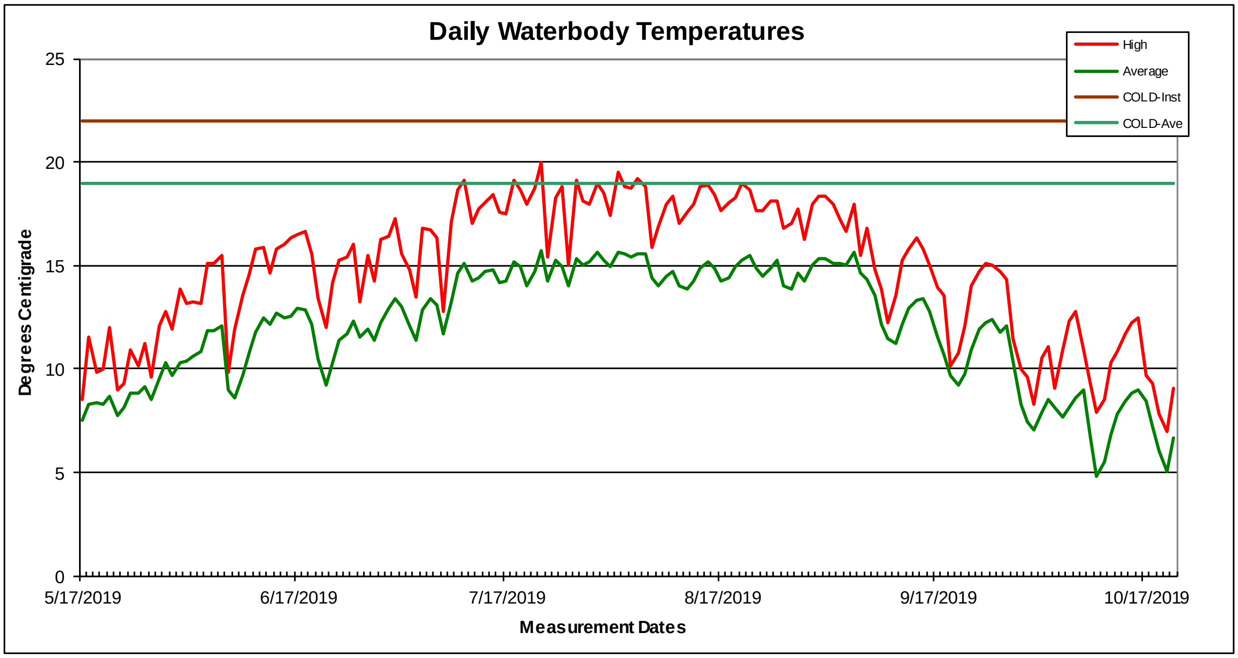
Figure C4. 2019 Temperature data for Cedar Creek in AU ID17040213SK006_03

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Browns Creek
Data Collection Site: 9935900
Data Period: 5/17/2019 - 10/21/2019

MDMT = 19.9, 22 Jul
MWMT = 18.7, 05 Aug
MDAT = 15.7, 22 Jul
MWAT = 15.4, 05 Aug

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK008_02



Idaho Cold Water Aquatic Life - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	93	21-Jun	1-Sep

Idaho Salmonid Spawning - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	42	70%	
9 °C Average Spring	48	80%	
Spring Days Eval'd w/in Dates	60	15-Mar	15-Jul

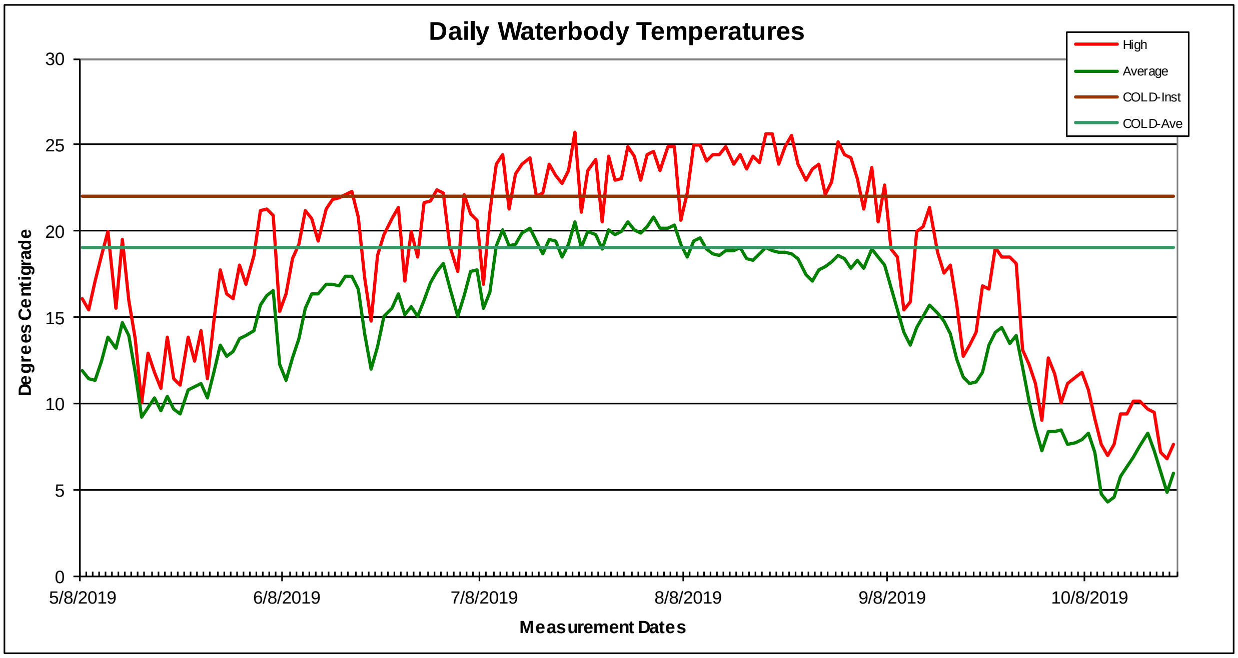
Figure C5. 2019 Temperature data for Browns Creek in AU ID17040213SK008_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: China Creek
Data Collection Site: 9935917
Data Period: 5/8/2019 - 10/21/2019

MDMT = 25.7, 22 Jul
MWMT = 24.8, 24 Aug
MDAT = 20.8, 03 Aug
MWAT = 20.3, 05 Aug

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK008_03



Idaho Cold Water Aquatic Life - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	57	61%	
19 °C Average	29	31%	
Days Evaluated & Date Range	93	21-Jun	1-Sep

Idaho Salmonid Spawning - 2019 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	61	88%	
9 °C Average Spring	69	100%	
Spring Days Eval'd w/in Dates	69	15-Mar	15-Jul

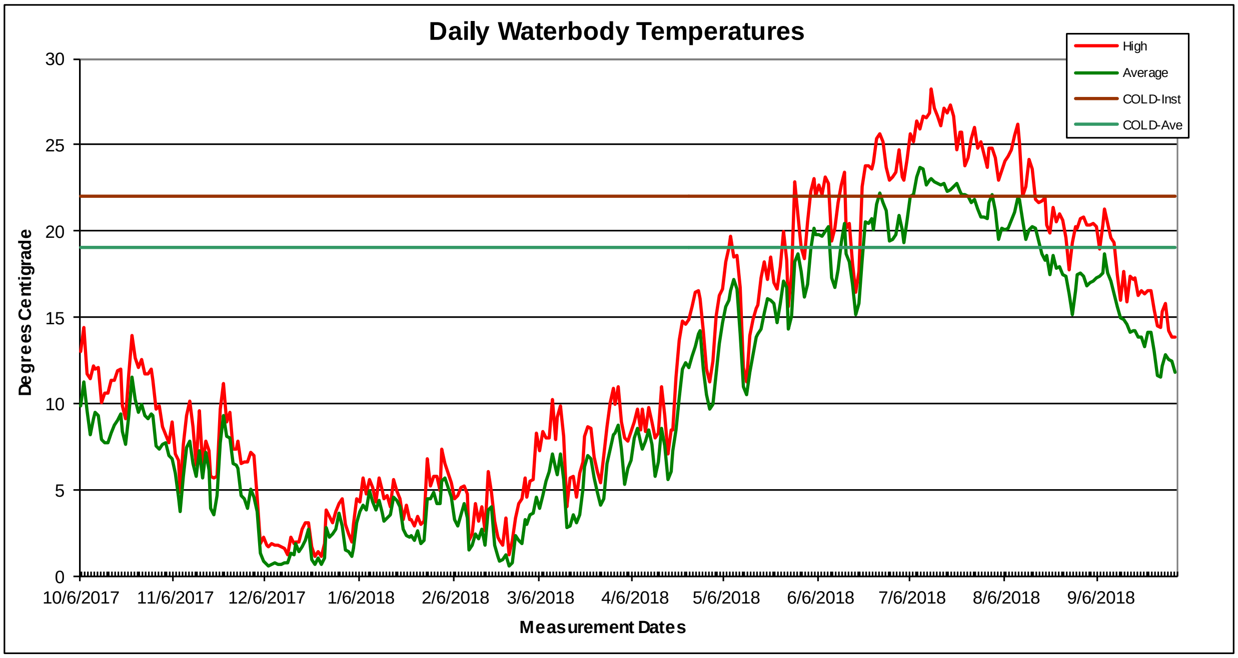
Figure C6. 2019 Temperature data for China Creek in AU ID17040213SK008_03

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Shoshone Creek
Data Collection Site: 10349624
Data Period: 10/6/2017 - 10/1/2018

MDMT = 28.3, 13 Jul
MWMT = 27.0, 19 Jul
MDAT = 23.7, 09 Jul
MWAT = 23.1, 14 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK011_04



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary				Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt		**Critical Date Criteria**	Nmbr	Prcnt	
22 °C Instantaneous	0	0%		22 °C Instantaneous	56	60%	
19 °C Average	0	0%		19 °C Average	58	62%	
Days Evaluated & Date Range	0	21-Jun	21-Sep	Days Evaluated & Date Range	93	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary				Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Criteria	Nmbr	Prcnt		**Criteria**	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%		13 °C Instantaneous Spring	81	66%	
9 °C Average Spring	0	0%		9 °C Average Spring	86	70%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul	Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

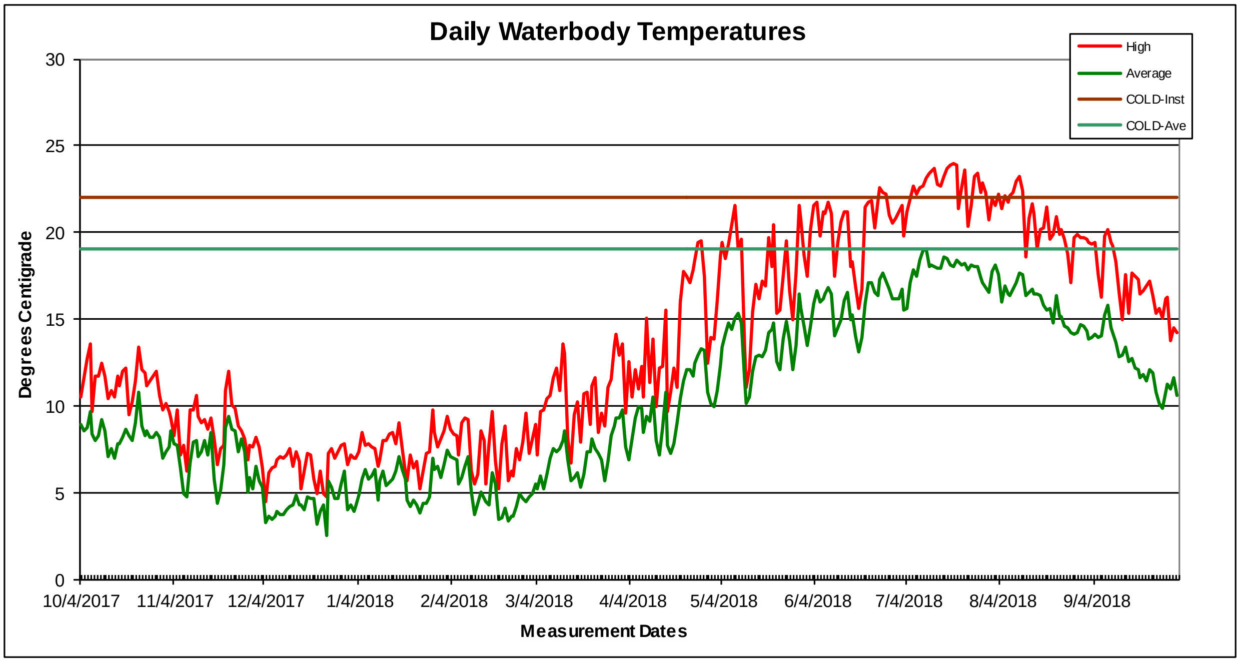
Figure C7. 2017-2018 Temperature data for Shoshone Creek in AU ID17040213SK011_04

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Hot Creek
Data Collection Site: 10349633
Data Period: 10/4/2017 - 10/1/2018

MDMT = 24.0, 19 Jul
MWMT = 23.4, 20 Jul
MDAT = 19.1, 10 Jul
MWAT = 18.4, 14 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK012_02



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary				Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt		Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%		22 °C Instantaneous	31	33%	
19 °C Average	0	0%		19 °C Average	1	1%	
Days Evaluated & Date Range	0	21-Jun	21-Sep	Days Evaluated & Date Range	93	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary				Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Criteria	Nmbr	Prcnt		Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%		13 °C Instantaneous Spring	90	73%	
9 °C Average Spring	0	0%		9 °C Average Spring	97	79%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul	Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

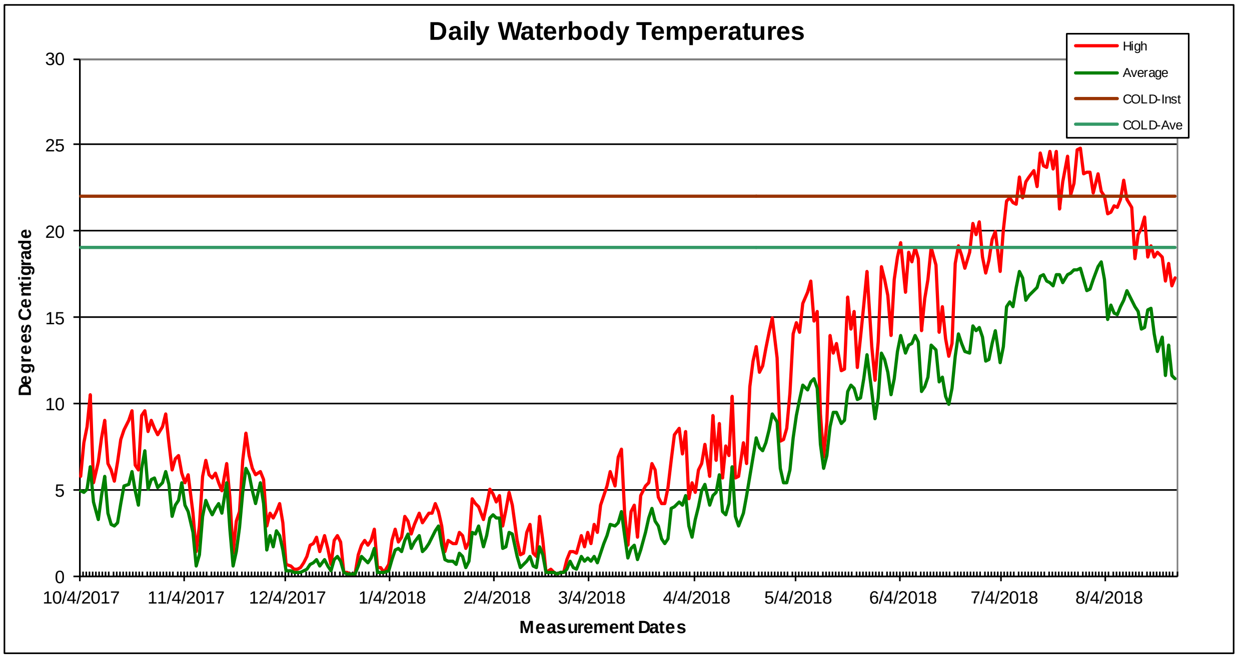
Figure C8. 2017-2018 Temperature data for Hot Creek in AU ID17040213SK012_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Big Creek
Data Collection Site: 10349635
Data Period: 10/4/2017 - 8/24/2018

MDMT = 24.8, 27 Jul
MWMT = 23.9, 20 Jul
MDAT = 18.2, 02 Aug
MWAT = 17.5, 27 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK014_02



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep

Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	25	38%	
19 °C Average	0	0%	
Days Evaluated & Date Range	65	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%	
9 °C Average Spring	0	0%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul

Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	69	56%	
9 °C Average Spring	69	56%	
Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

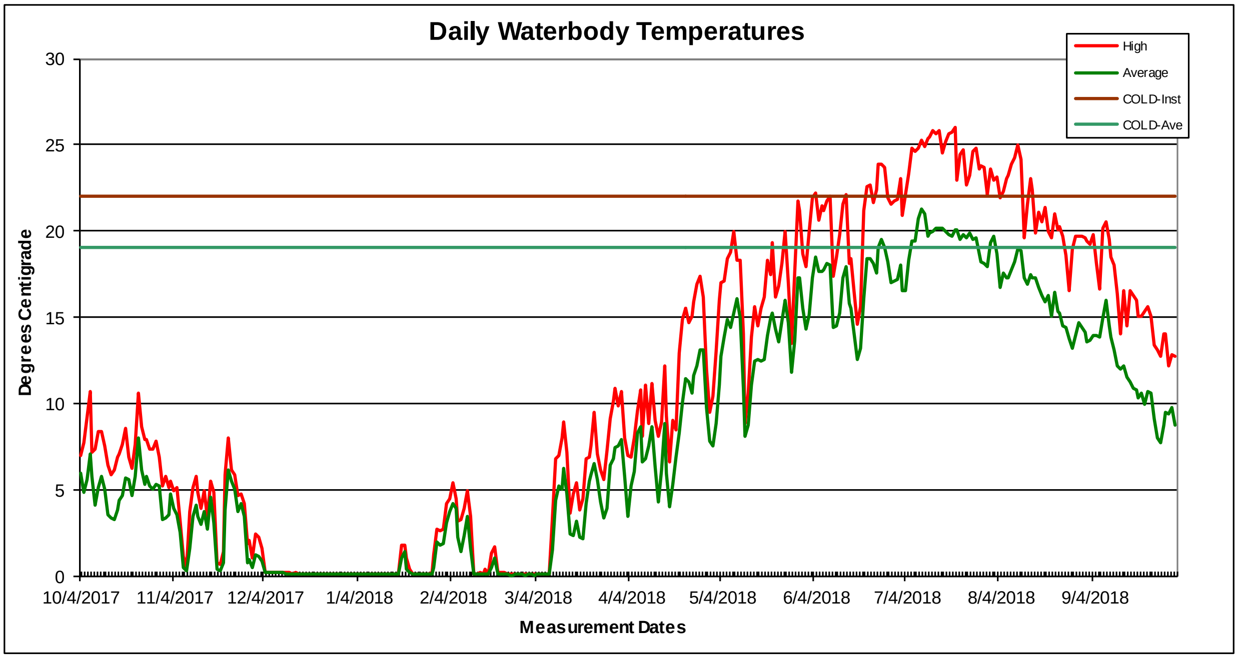
Figure C9. 2017-2018 Temperature data for Big Creek in AU ID17040213SK014_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Big Creek
Data Collection Site: 10349617
Data Period: 10/4/2017 - 10/1/2018

MDMT = 26.0, 20 Jul
MWMT = 25.5, 20 Jul
MDAT = 21.3, 09 Jul
MWAT = 20.4, 14 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK014_03



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary				Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt		Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%		22 °C Instantaneous	47	51%	
19 °C Average	0	0%		19 °C Average	27	29%	
Days Evaluated & Date Range	0	21-Jun	21-Sep	Days Evaluated & Date Range	93	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary				Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Criteria	Nmbr	Prcnt		Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%		13 °C Instantaneous Spring	80	65%	
9 °C Average Spring	0	0%		9 °C Average Spring	81	66%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul	Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

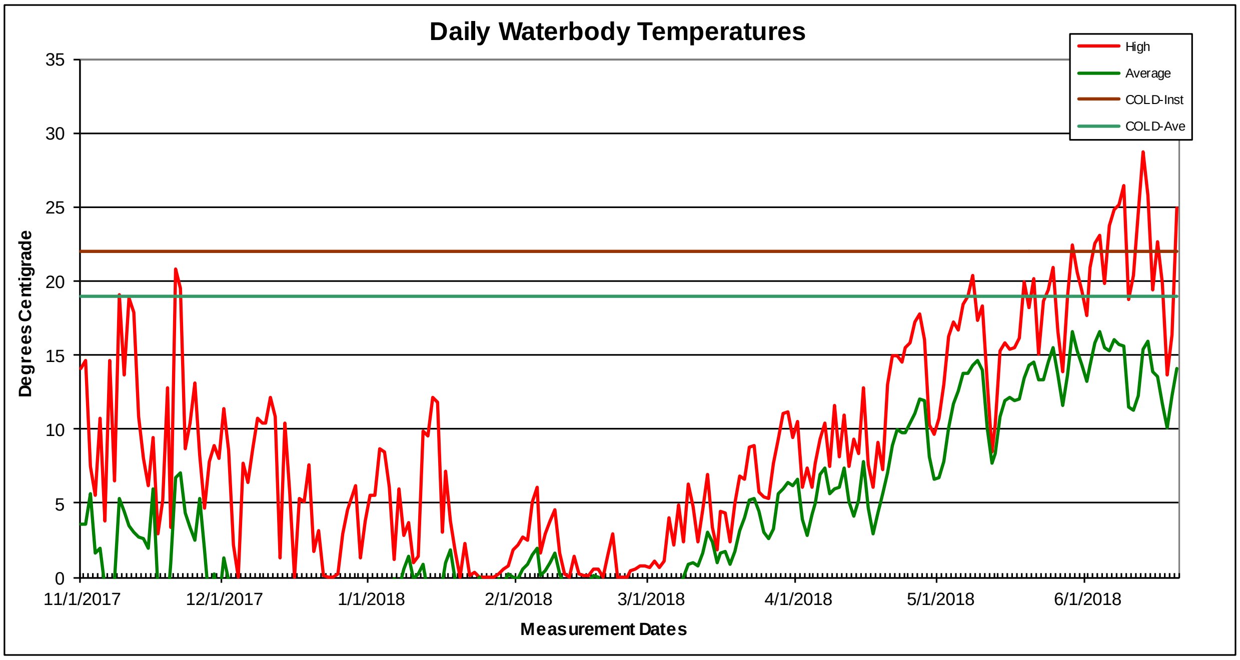
Figure C10. 2017-2018 Temperature data for Big Creek in AU ID17040213SK014_03

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Cottonwood Creek
Data Collection Site: 10349605
Data Period: 11/1/2017 - 6/20/2018

MDMT = 28.8, 13 Jun
MWMT = 24.3, 14 Jun
MDAT = 16.6, 04 Jun
MWAT = 15.8, 09 Jun

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK015_02



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary			
Critical Date Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep

Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
Critical Date Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	11	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary			
Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%	
9 °C Average Spring	0	0%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul

Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	66	61%	
9 °C Average Spring	65	60%	
Spring Days Eval'd w/in Dates	109	15-Mar	15-Jul

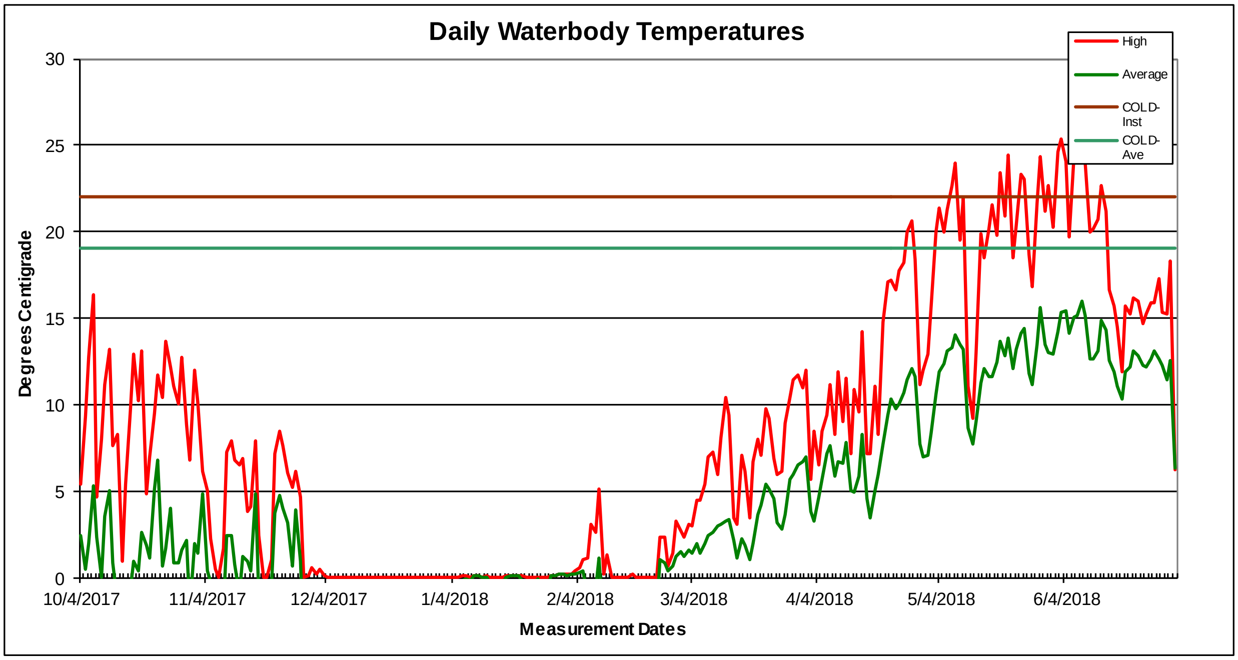
Figure C11. 2017-2018 Temperature data for Langford Flat Creek in AU ID17040213SK015_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Langford Flat Creek
Data Collection Site: 1260766
Data Period: 10/4/2017 - 7/1/2018

MDMT = 25.3, 03 Jun
MWMT = 23.9, 08 Jun
MDAT = 15.9, 08 Jun
MWAT = 15.2, 09 Jun

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: 015_03



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary				Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt		Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%		22 °C Instantaneous	0	0%	
19 °C Average	0	0%		19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep	Days Evaluated & Date Range	0	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary				Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Criteria	Nmbr	Prcnt		Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%		13 °C Instantaneous Spring	55	56%	
9 °C Average Spring	0	0%		9 °C Average Spring	54	55%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul	Spring Days Eval'd w/in Dates	98	15-Mar	15-Jul

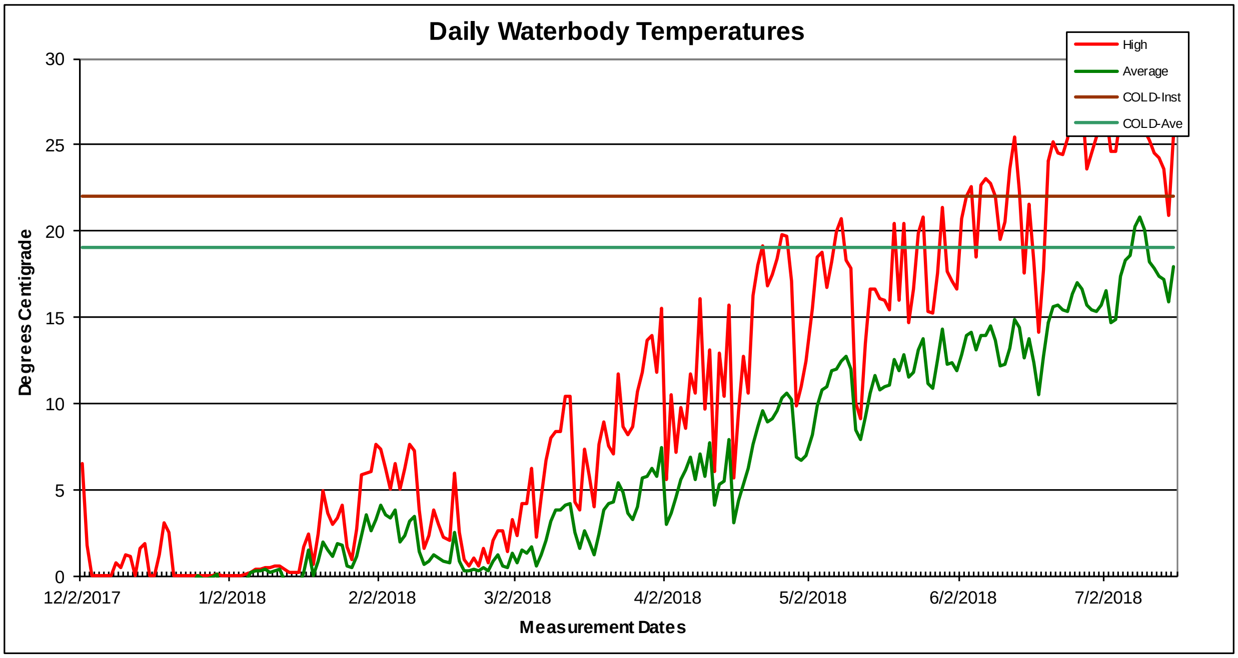
Figure C12. 2017-2018 Temperature data in Langford Flat Creek in AU ID17040213SK015_03

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Hopper Gulch
Data Collection Site: 10349604
Data Period: 12/2/2017 - 7/16/2018

MDMT = 28.2, 09 Jul
MWMT = 27.0, 11 Jul
MDAT = 20.8, 09 Jul
MWAT = 19.2, 12 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK016_02



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep

Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	25	96%	
19 °C Average	3	12%	
Days Evaluated & Date Range	26	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%	
9 °C Average Spring	0	0%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul

Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	88	72%	
9 °C Average Spring	73	59%	
Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

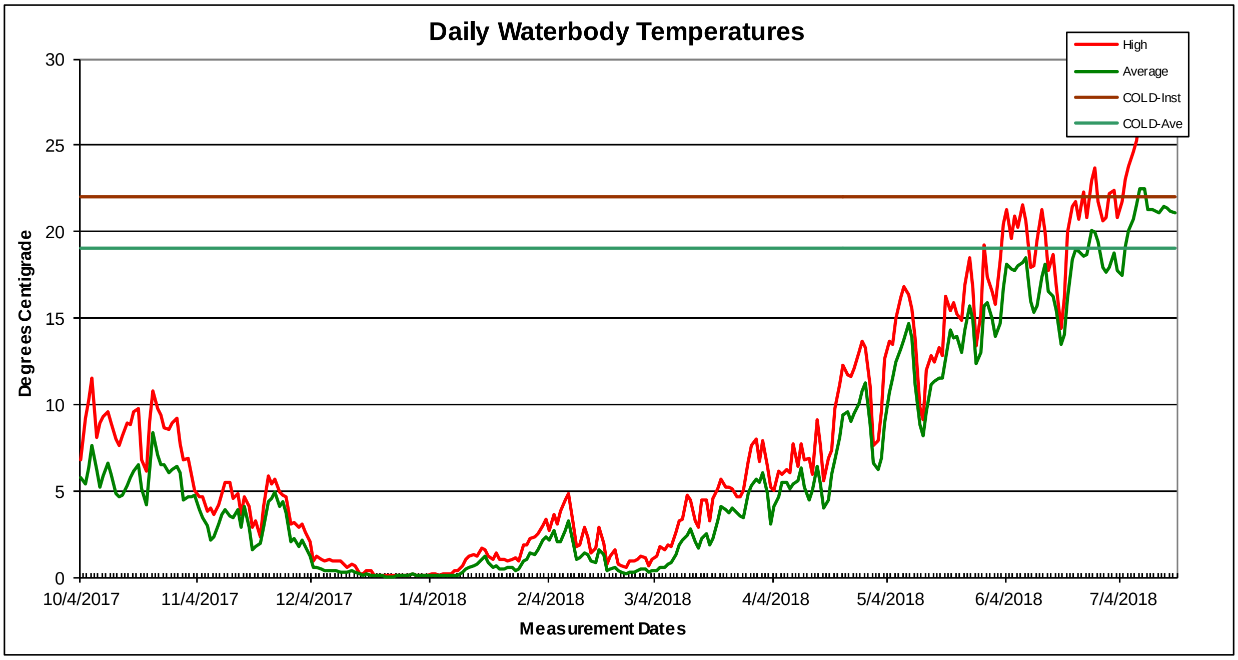
Figure C13. 2017-2018 Temperature data for Hopper Gulch in AU ID17040213SK016_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: SF Shoshone Creek
Data Collection Site: 10349611
Data Period: 10/4/2017 - 7/18/2018

MDMT = 28.0, 18 Jul
MWMT = 26.7, 18 Jul
MDAT = 22.5, 10 Jul
MWAT = 21.6, 14 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK016_03



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary				Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt		Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%		22 °C Instantaneous	19	68%	
19 °C Average	0	0%		19 °C Average	17	61%	
Days Evaluated & Date Range	0	21-Jun	21-Sep	Days Evaluated & Date Range	28	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary				Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Criteria	Nmbr	Prcnt		Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%		13 °C Instantaneous Spring	69	56%	
9 °C Average Spring	0	0%		9 °C Average Spring	78	63%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul	Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

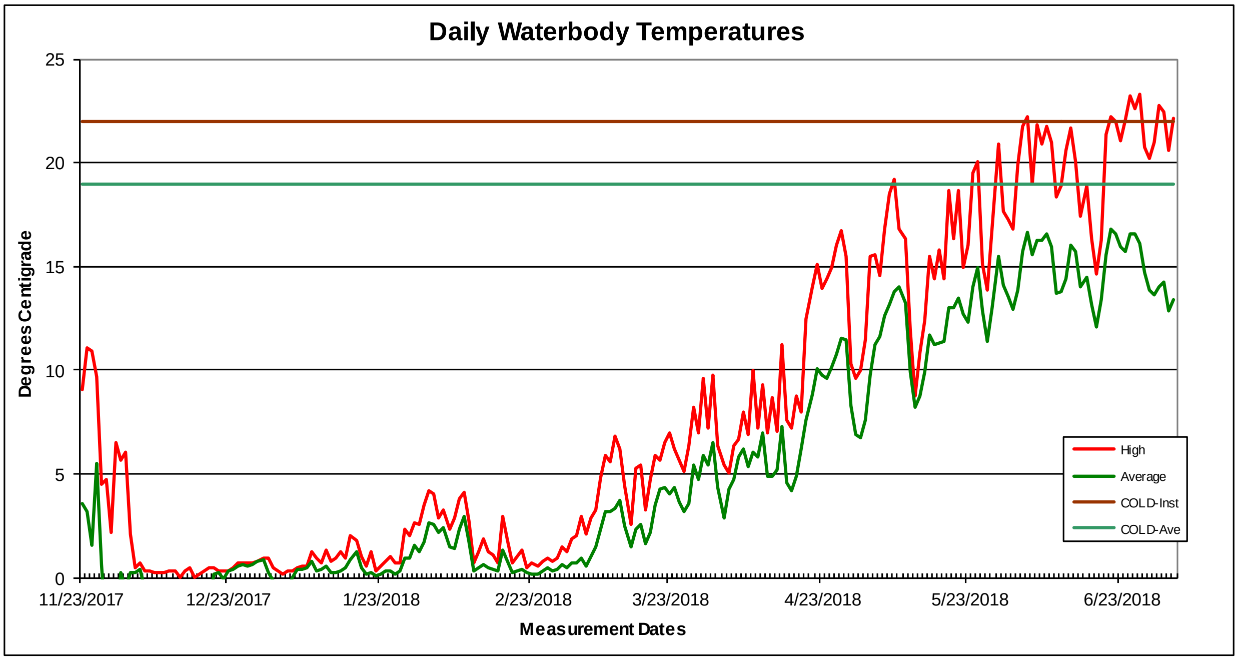
Figure C14. 2017-2018 Temperature data for SF Shoshone Creek in AU ID17040213SK016_03

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Shoshone Creek
Data Collection Site: 10349642
Data Period: 11/23/2017 - 7/4/2018

MDMT = 23.3, 27 Jun
MWMT = 22.3, 27 Jun
MDAT = 16.8, 21 Jun
MWAT = 16.3, 27 Jun

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK016_03



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary				Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt		Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%		22 °C Instantaneous	8	57%	
19 °C Average	0	0%		19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep	Days Evaluated & Date Range	14	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary				Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Criteria	Nmbr	Prcnt		Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%		13 °C Instantaneous Spring	67	60%	
9 °C Average Spring	0	0%		9 °C Average Spring	68	61%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul	Spring Days Eval'd w/in Dates	112	15-Mar	15-Jul

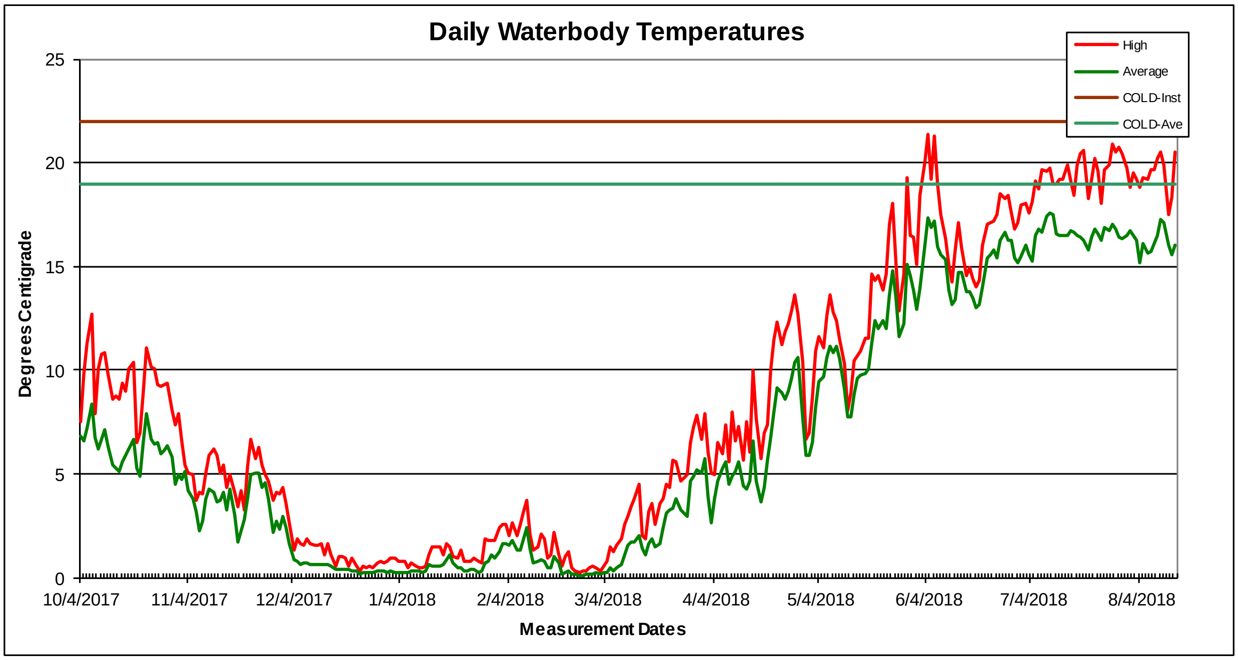
Figure C15. 2017-2018 Temperature data for Shoshone Creek in AU ID17040213SK016_03

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: SF Shoshone Creek
Data Collection Site: 10349646
Data Period: 10/4/2017 - 8/14/2018

MDMT = 21.4, 04 Jun
MWMT = 20.3, 31 Jul
MDAT = 17.6, 09 Jul
MWAT = 17.0, 12 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK016_02



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep

Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	55	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%	
9 °C Average Spring	0	0%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul

Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	59	48%	
9 °C Average Spring	74	60%	
Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

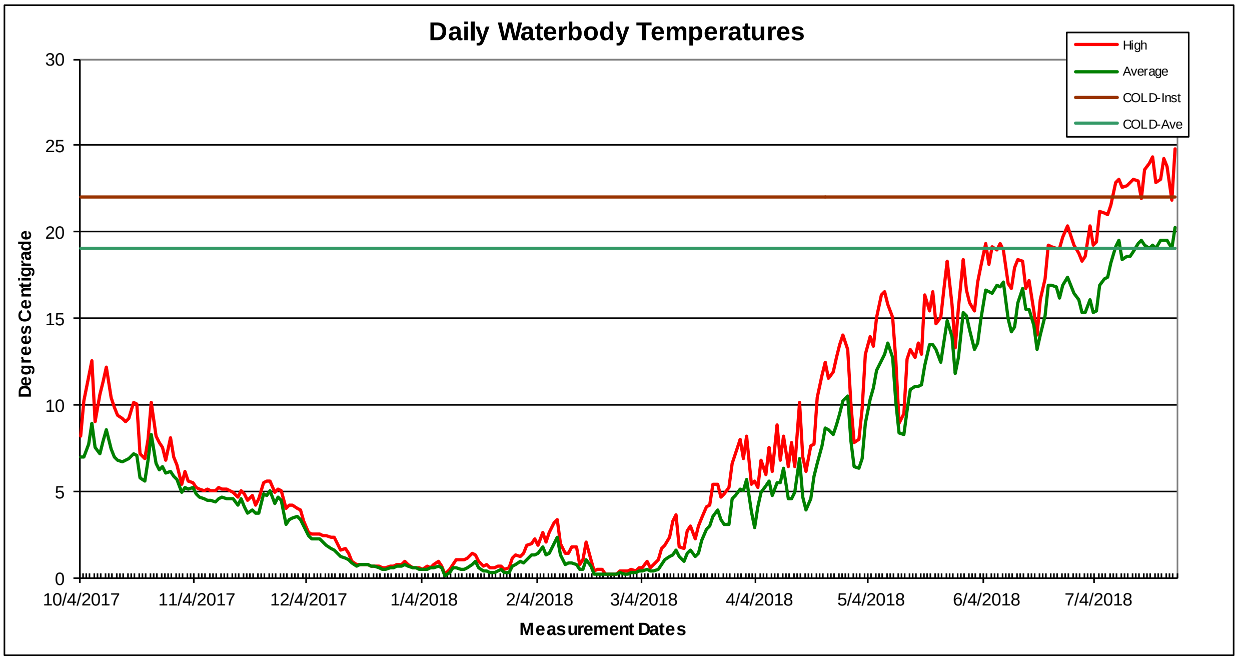
Figure C16. 2017-2018 Temperature data for SF Shoshone Creek in AU ID17040213SK016_02

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: MF Shoshone Creek
Data Collection Site: 10349650
Data Period: 10/4/2017 - 7/25/2018

MDMT = 24.8, 25 Jul
MWMT = 23.7, 23 Jul
MDAT = 20.2, 25 Jul
MWAT = 19.4, 25 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK016_03



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep

Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	15	43%	
19 °C Average	13	37%	
Days Evaluated & Date Range	35	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%	
9 °C Average Spring	0	0%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul

Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts		
Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	70	57%	
9 °C Average Spring	74	60%	
Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

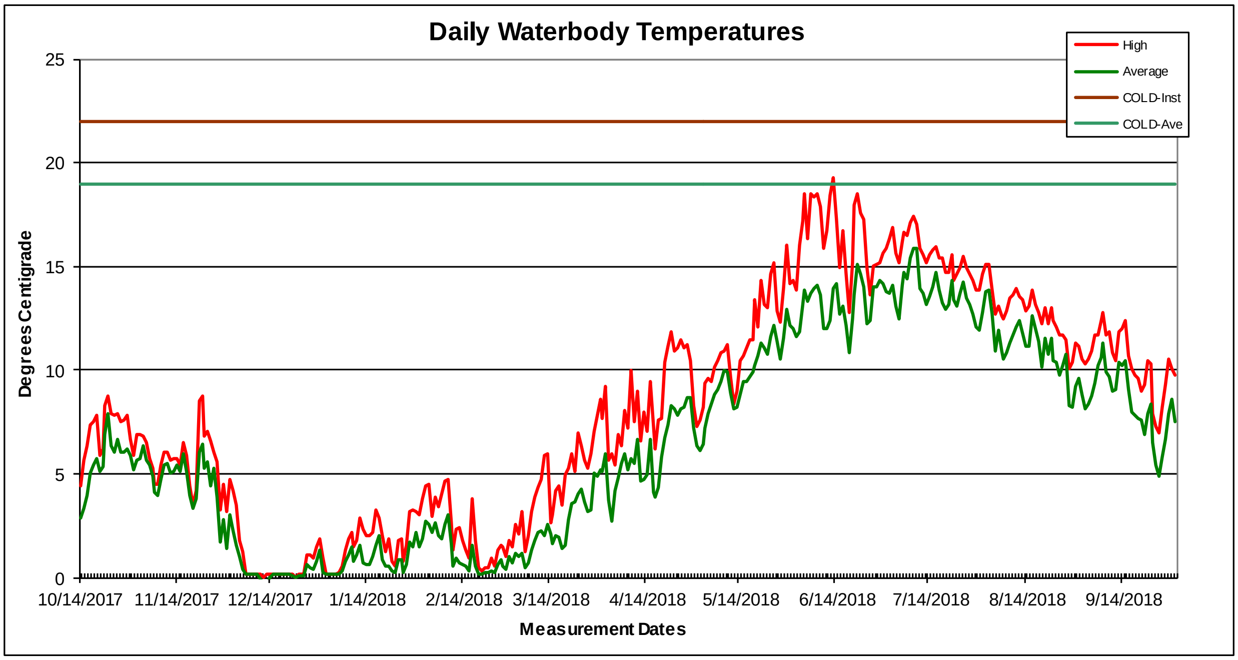
Figure C17. 2017-2018 Temperature data for MF Shoshone Creek in AU ID17040213SK016_03

DEQ Summary of Temperature Data

Data Source: TFRO
Water Body: Pole Camp Creek
Data Collection Site: 10724006
Data Period: 10/14/2017 - 10/1/2018

MDMT = 19.3, 13 Jun
MWMT = 17.9, 09 Jun
MDAT = 15.9, 10 Jul
MWAT = 14.9, 11 Jul

HUC4 Number: 17040213
HUC4 Name: Salmon Falls
South of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1400 M
Waterbody ID Number: SK016_02



Idaho Cold Water Aquatic Life - 2017 Criteria Exceedance Summary				Idaho Cold Water Aquatic Life - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Critical Date Criteria	Nmbr	Prcnt		Critical Date Criteria	Nmbr	Prcnt	
22 °C Instantaneous	0	0%		22 °C Instantaneous	0	0%	
19 °C Average	0	0%		19 °C Average	0	0%	
Days Evaluated & Date Range	0	21-Jun	21-Sep	Days Evaluated & Date Range	93	21-Jun	21-Sep

Idaho Salmonid Spawning - 2017 Criteria Exceedance Summary				Idaho Salmonid Spawning - 2018 Criteria Exceedance Summary			
	Exceedance Counts				Exceedance Counts		
Criteria	Nmbr	Prcnt		Criteria	Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%		13 °C Instantaneous Spring	53	43%	
9 °C Average Spring	0	0%		9 °C Average Spring	66	54%	
Spring Days Eval'd w/in Dates	0	15-Mar	15-Jul	Spring Days Eval'd w/in Dates	123	15-Mar	15-Jul

Figure C18. 2017-2018 Temperature data for Pole Camp Creek in AU ID17040213SK016_02

Bankfull Width Estimates

Table C2. Bankfull width estimates in Salmon Falls Creek subbasin.

Salmon Falls Creek - Devil Creek to mouth
ID17040213SK001_06

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Salmon Falls Creek @ Balanced Rock Road	2125.5	46	
Salmon Falls Creek @ Snake River	2189.6	46	

Dam controlled segment. Stream widths do not match reflect dam operations

Devil Creek
ID17040213SK002_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Devil Creek @ Camas Slough	25.0	6	
Devil Creek @ Marshall Butte Crossing	68.8	10	
Devil Creek @ John Boyd Draw	80.6	11	
Devil Creek @ Devil Creek Ranch	6.9	4	
John Boyd Draw	40.8	8	
Conover Ranch Creek	18.8	6	

Devil Creek - 4th order segment to mouth
ID17040213SK002_04

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Devil Creek @ John Boyd Draw	80.6	11	
Devil Creek @ Salmon Falls Creek	158.6	15	

All streams in AU are intermittent. No shade values attributed to streams.

Salmon Falls Creek - Salmon Falls Creek Dam to Devil Creek
ID17040213SK003_06

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Salmon Falls Creek @ Devil Creek	1959.0	44	

Dam controlled segment. Stream widths do not match reflect dam operations

01 & 02 tribs Cedar Creek Reservoir
ID17040213SK004_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
		0	

All streams in AU are intermittent. No shade values attributed to streams.

House Creek - source to Cedar Creek Reservoir

ID17040213SK005_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
House Creek @ Jack Walker Draw	2.9	3	2
House Creek @ Taylor Creek	9.1	4	
Taylor Creek	4.0	3	
Taylor Creek Tributary	1.3	2	
House Creek_Trib 01	3.4	3	
House Creek @ House Creek_Trib 01		0	
Little House Creek @ State Land	4.1	3	3
Little House Creek	8.3	4	
House Creek_Trib 02	1.6	2	

House Creek - source to Cedar Creek Reservoir
ID17040213SK005_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
House Creek	42.6	8	

House Creek - source to Cedar Creek Reservoir
ID17040213SK005_04

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
House Creek	49.1	9	3.5

Cedar Creek - source to Cedar Creek Reservoir
ID17040213SK006_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Cedar Creek @ Dove Spring	8.2	4	2.5
Cedar Creek	13.1	5	4
Indian Jim Canyon	3.1	3	

Cedar Creek - source to Cedar Creek Reservoir
ID17040213SK006_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Cedar Creek	28.1	7	4

China, Browns, Corral, Player Creeks
ID17040213SK008_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Player Creek	4.7	3	2
China Creek	2.7	2	2
China Creek_Trib 02	9.6	4	
China Creek_Trib 03	2.2	2	

Deer Canyon	3.5	3	
China Creek Ranch Springs	1.2	2	
Browns Creek	4.7	3	2
Corral Creek	5.0	3	
Corral Creek_Trib 01	0.7	1	

China Creek
ID17040213SK008_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
China Creek	22.6	6	

Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek
ID17040213SK009_06

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Salmon Falls Creek	1486.7	39	15

North Fork Salmon Falls Creek-source to Idaho/Nevada border
ID17040213SK010_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Bear Creek	2.2	2	
Bear Creek Tributary	1.3	2	
Meadow Springs	1.3	2	2.5
Barbour Creek	5.4	3	
Rocky Canyon Creek	3.2	3	1.5
North Fork Salmon Falls Creek @ Rocky Canyon Creek	2.3	2	1.5
North Fork Salmon Falls Creek	5.8	3	

North Fork Salmon Falls Creek-source to Idaho/Nevada border
ID17040213SK010_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
North Fork Salmon Falls Creek	17.1	5	

Shoshone Creek - Hot Creek to Idaho/Nevada border
ID17040213SK011_04

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Shoshone Creek	242.7	18	7.5

Hot Creek - Idaho/Nevada border to mouth
ID17040213SK012_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Horse Creek	4.3	3	

Hot Creek - Idaho/Nevada border to mouth
ID17040213SK012_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Horse Creek	17.4	6	

Hot Creek
ID17040213SK012_03A

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Hot Creek @ Stateline	28.3	7	
Hot Creek	56.3	9	1.5

Hot Creek - Idaho/Nevada border to mouth
ID17040213SK012_04

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Shoshone Creek	142.6	14	6

Shoshone Creek - Cottonwood Creek to Hot Creek
ID17040213SK013_04

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Shoshone Creek @ Horse Creek	125.1	13	
Shoshone Creek @ Big Creek	97.1	12	8

Big Creek - source to mouth
ID17040213SK014_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Big Creek_Trib 01	0.9	2	
Big Creek @ Dry Gulch	5.2	3	2
Dry Gulch	1.6	2	
Big Creek @ Basque Spring	10.7	4	
Basque Spring	1.3	2	
Big Creek @ Hannahs Fork	14.9	5	
North Fork Hannahs Fork	1.1	2	
Middle Fork Hannahs Fork	1.3	2	
Willow Spring Creek	0.7	1	
South Hannahs Fork	1.9	2	

Big Creek - source to mouth
ID17040213SK014_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Hannahs Fork	5.8	3	
Big Creek	25.7	7	2.5

Cottonwood Creek - source to mouth
ID17040213SK015_02

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Diamond Creek	1.3	2	
Jack Creek	1.4	2	
Cottonwood Creek @ Jack Creek	2.5	2	
Eagle Spring Creek	1.0	2	
Cottonwood Creek @ Eagle Spring Creek	6.4	4	2
Cottonwood Creek @ Sheep Spring Creek	9.7	4	3
Cottonwood Creek_Trib 01	1.4	2	
Cottonwood Creek @ Cottonwood Creek_trib 01	12.0	5	
Van Eaton Spring	3.1	3	
Cottonwood Creek @ Van Eaton Spring	14.0	5	
Cottonwood Creek	19.6	6	
Lamb Spring	2.6	2	2
Langford Flat Creek	2.4	2	

Cottonwood Creek - source to mouth
ID17040213SK015_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Langford Flat Creek	27.2	7	

Shoshone Creek - source to Cottonwood Creek
ID17040213SK016_02

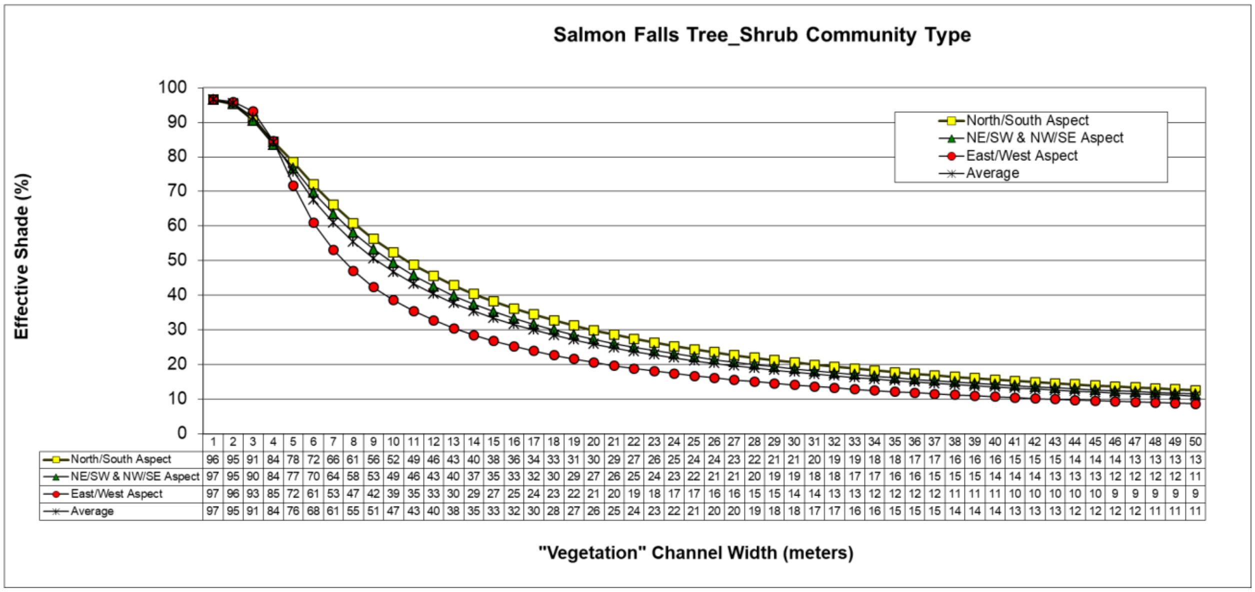
Location	Area (sq mi)	Upper Snake (m)	BURP (m)
Middle Fork Shoshone Creek @ Summit Spring	0.8	1	
Summit Spring	1.6	2	
Middle Fork Shoshone Creek	4.8	3	
South Fork Shoshone Creek_Trib 01	0.8	1	
South Fork Shoshone Creek @ Middle Fork Shoshone Creek	4.3	3	
Shoshone Creek @ South Fork Shoshone Creek	3.4	3	
Pole Camp Creek_Trib 01	0.8	1	
Pole Camp Creek_Trib 02	1.0	2	
Bone Spring	0.7	1	
Pole Camp Creek	4.9	3	
Hopper Gulch	2.5	2	

Nelson Spring	6.7	4	

Shoshone Creek - source to Cottonwood Creek
ID17040213SK016_03

Location	Area (sq mi)	Upper Snake (m)	BURP (m)
South Fork Shoshone Creek @ Shoshone Creek	11.2	5	
Shoshone Creek @ Lone Pine Spring	27.6	7	8
Shoshone Creek @ Langford Flat Creek	44.2	8	

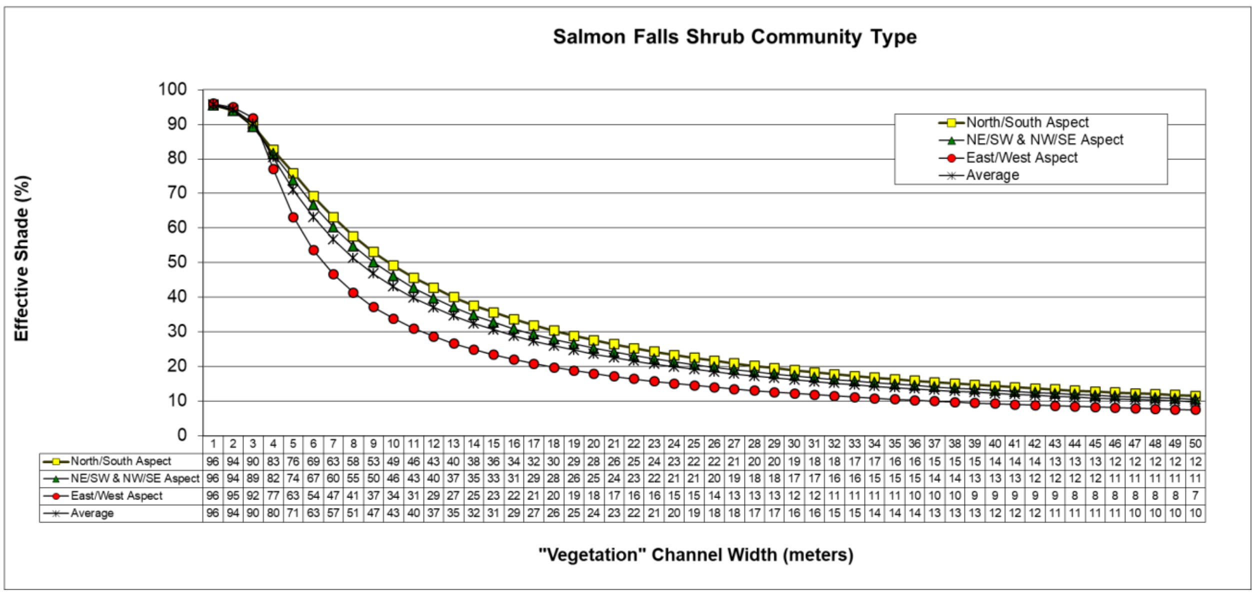
Selected Shade Curves



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	96	95	91	84	78	72	66	61	56	52	49	46	43	40	38	36	34	33	31	30	29	27	26	25	24
NE/SW & NW/SE Aspect	97	95	90	84	77	70	64	58	53	49	46	43	40	37	35	33	32	30	29	27	26	25	24	23	22
East/West Aspect	97	96	93	85	72	61	53	47	42	39	35	33	30	29	27	25	24	23	22	21	20	19	18	17	17
Average	97	95	91	84	76	68	61	55	51	47	43	40	38	35	33	32	30	28	27	26	25	24	23	22	21

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	24	23	22	21	21	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	13	13	13	13
NE/SW & NW/SE Aspect	21	21	20	19	19	18	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11
East/West Aspect	16	16	15	15	14	14	13	13	12	12	12	12	11	11	11	10	10	10	10	10	9	9	9	9	9
Average	20	20	19	18	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11

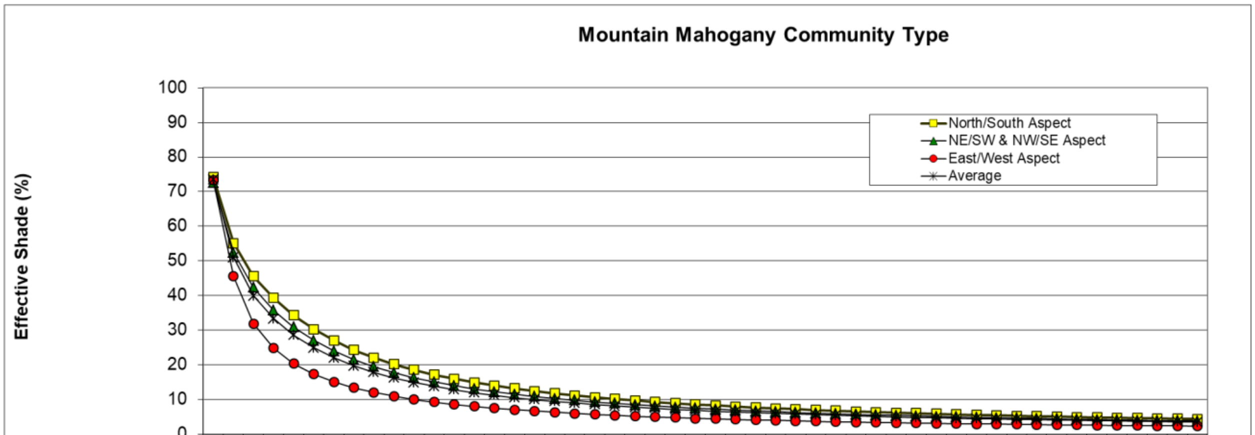
Figure C19. Salmon Falls Creek tree/shrub community type shade curve.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	96	94	90	83	76	69	63	58	53	49	46	43	40	38	36	34	32	30	29	28	26	25	24	23	22
NE/SW & NW/SE Aspect	96	94	89	82	74	67	60	55	50	46	43	40	37	35	33	31	29	28	26	25	24	23	22	21	21
East/West Aspect	96	95	92	77	63	54	47	41	37	34	31	29	27	25	23	22	21	20	19	18	17	16	16	15	15
Average	96	94	90	80	71	63	57	51	47	43	40	37	35	32	31	29	27	26	25	24	23	22	21	20	19

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	22	21	20	20	19	18	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	12
NE/SW & NW/SE Aspect	20	19	18	18	17	17	16	16	15	15	15	14	14	13	13	13	12	12	12	12	11	11	11	11	11
East/West Aspect	14	13	13	13	12	12	11	11	11	11	10	10	10	9	9	9	9	9	8	8	8	8	8	8	7
Average	18	18	17	17	16	16	15	15	14	14	14	13	13	13	12	12	12	11	11	11	11	10	10	10	10

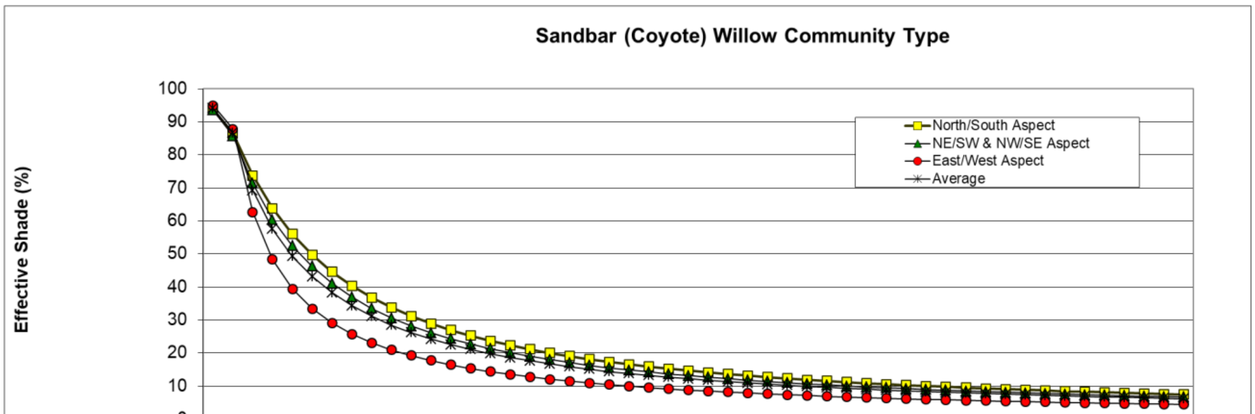
Figure C20. Salmon Falls Creek shrub community type shade curve.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	74	55	46	39	34	30	27	24	22	20	19	17	16	15	14	13	12	12	11	11	10	10	9	9	9
NE/SW & NW/SE Aspect	73	52	42	36	31	27	24	21	19	18	16	15	14	13	12	11	11	10	10	9	9	8	8	8	7
East/West Aspect	73	46	32	25	20	17	15	13	12	11	10	9	9	8	7	7	7	6	6	6	5	5	5	5	5
Average	73	51	40	33	29	25	22	20	18	16	15	14	13	12	11	11	10	9	9	9	8	8	7	7	7

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	8	8	8	7	7	7	7	7	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5	4	4
NE/SW & NW/SE Aspect	7	7	7	6	6	6	6	6	6	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4
East/West Aspect	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
Average	7	6	6	6	6	6	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3

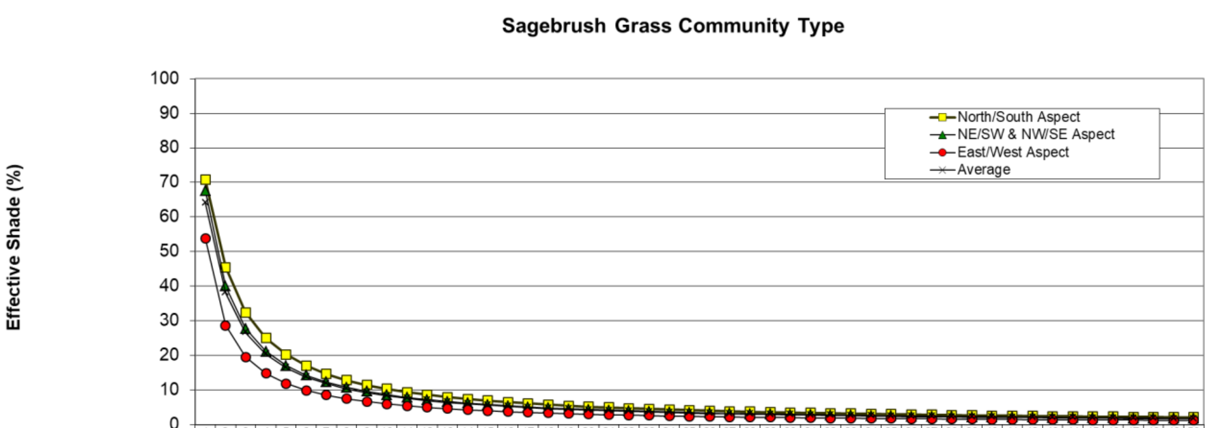
Figure C21. Salmon Falls Creek mountain mahogany community type shade curve.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	94	86	74	64	56	50	45	40	37	34	31	29	27	25	24	22	21	20	19	18	17	17	16	15	15
NE/SW & NW/SE Aspect	94	86	71	60	53	46	41	37	34	31	28	26	24	23	21	20	19	18	17	16	16	15	14	14	13
East/West Aspect	95	88	63	48	39	33	29	26	23	21	19	18	16	15	14	14	13	12	12	11	10	10	10	9	9
Average	94	87	69	58	49	43	38	34	31	28	26	24	23	21	20	19	18	17	16	15	14	14	13	13	12

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	14	14	13	13	12	12	12	11	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	8	7
NE/SW & NW/SE Aspect	13	12	12	11	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7
East/West Aspect	8	8	8	8	7	7	7	7	7	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5	4
Average	12	11	11	11	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	6	6	6

Figure C22. Salmon Falls Creek sandbar (coyote) willow community type shade curve.

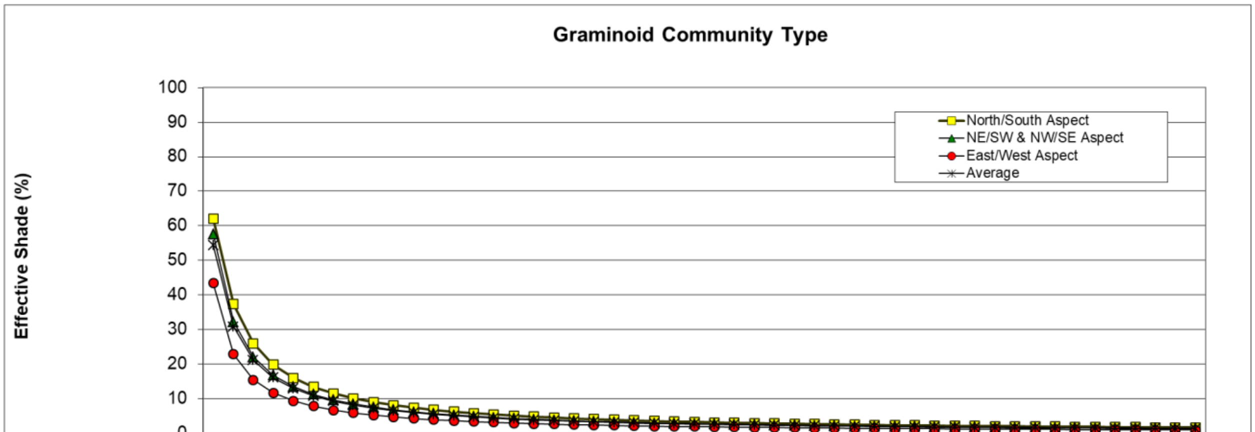


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	71	45	32	25	20	17	15	13	11	10	9	9	8	7	7	6	6	6	5	5	5	5	5	4	4
NE/SW & NW/SE Aspect	68	40	28	21	17	14	12	11	10	9	8	7	7	6	6	5	5	5	5	4	4	4	4	4	3
East/West Aspect	54	29	19	15	12	10	9	7	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2
Average	64	38	27	20	16	14	12	10	9	8	8	7	6	6	6	5	5	5	4	4	4	4	4	3	3

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2
NE/SW & NW/SE Aspect	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
East/West Aspect	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
Average	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

"Vegetation" Channel Width (meters)

Figure C23. Salmon Falls Creek sagebrush/grass community type shade curve.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	62	37	26	20	16	13	12	10	9	8	7	7	6	6	5	5	5	5	4	4	4	4	4	3	3
NE/SW & NW/SE Aspect	58	32	22	17	13	11	10	8	8	7	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3
East/West Aspect	43	23	15	12	9	8	7	6	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2
Average	54	31	21	16	13	11	9	8	7	7	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
NE/SW & NW/SE Aspect	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1
East/West Aspect	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1

"Vegetation" Channel Width (meters)

Figure C24. Salmon Falls Creek grass community type shade curve.

Solar Load Tables

Table C3. Target and existing solar loads for Salmon Falls Creek - Devil Creek to mouth (AU ID17040213SK001_06)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
001_06	Salmon Falls Creek	35	7624	Coyote willow	49%	3.20	5	40,000	100,000	30%	4.39	5	40,000	200,000	100,000	-19%
001_06	Salmon Falls Creek	37	184	Coyote willow	49%	3.20	5	900	3,000	10%	5.64	5	900	5,000	2,000	-39%
001_06	Salmon Falls Creek	38	694	Coyote willow	49%	3.20	5	3,000	10,000	30%	4.39	5	3,000	10,000	0	-19%
001_06	Salmon Falls Creek	39	1482	Coyote willow	49%	3.20	5	7,000	20,000	10%	5.64	5	7,000	40,000	20,000	-39%
001_06	Salmon Falls Creek	40	2728	Coyote willow	49%	3.20	5	10,000	30,000	10%	5.64	5	10,000	60,000	30,000	-39%
001_06	Salmon Falls Creek	41	377	Coyote willow	43%	3.57	6	2,000	7,000	0%	6.27	6	2,000	10,000	3,000	-43%
001_06	Salmon Falls Creek	42	865	Coyote willow	43%	3.57	6	5,000	20,000	20%	5.02	6	5,000	30,000	10,000	-23%
001_06	Salmon Falls Creek	43	789	Coyote willow	43%	3.57	6	5,000	20,000	10%	5.64	6	5,000	30,000	10,000	-33%
001_06	Salmon Falls Creek	45	687	Coyote willow	43%	3.57	6	4,000	10,000	40%	3.76	6	4,000	20,000	10,000	-3%
001_06	Salmon Falls Creek	46	173	Coyote willow	43%	3.57	6	1,000	4,000	10%	5.64	6	1,000	6,000	2,000	-33%
001_06	Salmon Falls Creek	47	187	Coyote willow	43%	3.57	6	1,000	4,000	30%	4.39	6	1,000	4,000	0	-13%
001_06	Salmon Falls Creek	48	348	Coyote willow	43%	3.57	6	2,000	7,000	20%	5.02	6	2,000	10,000	3,000	-23%
001_06	Salmon Falls Creek	49	1702	Coyote willow	43%	3.57	6	10,000	40,000	20%	5.02	6	10,000	50,000	10,000	-23%
001_06	Salmon Falls Creek	50	1177	Coyote willow	43%	3.57	6	7,000	30,000	10%	5.64	6	7,000	40,000	10,000	-33%
001_06	Salmon Falls Creek	52	2472	Coyote willow	43%	3.57	6	10,000	40,000	20%	5.02	6	10,000	50,000	10,000	-23%
001_06	Salmon Falls Creek	53	474	Coyote willow	43%	3.57	6	3,000	10,000	10%	5.64	6	3,000	20,000	10,000	-33%
001_06	Salmon Falls Creek	54	188	Coyote willow	43%	3.57	6	1,000	4,000	10%	5.64	6	1,000	6,000	2,000	-33%
001_06	Salmon Falls Creek	55	199	Coyote willow	43%	3.57	6	1,000	4,000	10%	5.64	6	1,000	6,000	2,000	-33%
001_06	Salmon Falls Creek	56	622	Coyote willow	43%	3.57	6	4,000	10,000	20%	5.02	6	4,000	20,000	10,000	-23%
001_06	Salmon Falls Creek	57	480	Coyote willow	38%	3.89	7	3,000	10,000	10%	5.64	7	3,000	20,000	10,000	-28%

001_06	Salmon Falls Creek	58	2392	Coyote willow	38%	3.89	7	20,000	80,000	10%	5.64	7	20,000	100,000	20,000	-28%
001_06	Salmon Falls Creek	59	303	Coyote willow	38%	3.89	7	2,000	8,000	10%	5.64	7	2,000	10,000	2,000	-28%
001_06	Salmon Falls Creek	60	560	Coyote willow	38%	3.89	7	4,000	20,000	10%	5.64	7	4,000	20,000	0	-28%
001_06	Salmon Falls Creek	61	2119	Coyote willow	38%	3.89	7	10,000	40,000	10%	5.64	7	10,000	60,000	20,000	-28%
001_06	Salmon Falls Creek	62	730	Coyote willow	38%	3.89	7	5,000	20,000	0%	6.27	7	5,000	30,000	10,000	-38%
001_06	Salmon Falls Creek	63	180	Coyote willow	38%	3.89	7	1,000	4,000	10%	5.64	7	1,000	6,000	2,000	-28%
001_06	Salmon Falls Creek	64	418	Coyote willow	38%	3.89	7	3,000	10,000	10%	5.64	7	3,000	20,000	10,000	-28%
001_06	Salmon Falls Creek	65	423	Coyote willow	38%	3.89	7	3,000	10,000	0%	6.27	7	3,000	20,000	10,000	-38%
001_06	Salmon Falls Creek	66	798	Coyote willow	38%	3.89	7	6,000	20,000	0%	6.27	7	6,000	40,000	20,000	-38%
001_06	Salmon Falls Creek	67	511	Coyote willow	38%	3.89	7	4,000	20,000	0%	6.27	7	4,000	30,000	10,000	-38%
001_06	Salmon Falls Creek	68	283	Coyote willow	38%	3.89	7	2,000	8,000	10%	5.64	7	2,000	10,000	2,000	-28%
001_06	Salmon Falls Creek	69	342	Coyote willow	38%	3.89	7	2,000	8,000	10%	5.64	7	2,000	10,000	2,000	-28%
001_06	Salmon Falls Creek	70	447	Coyote willow	38%	3.89	7	3,000	10,000	0%	6.27	7	3,000	20,000	10,000	-38%
001_06	Salmon Falls Creek	71	304	Coyote willow	38%	3.89	7	2,000	8,000	10%	5.64	7	2,000	10,000	2,000	-28%
001_06	Salmon Falls Creek	72	188	Coyote willow	38%	3.89	7	1,000	4,000	0%	6.27	7	1,000	6,000	2,000	-38%
							Totals		650,000					1,000,000	380,000	

Table C4. Target and existing solar loads for Devil Creek (AU ID17040213SK002_03)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
002_03	Devil Creek	1	917	Coyote willow	94%	0.38	1	900	300	10%	5.64	1	900	5,000	5,000	-84%
002_03	Devil Creek	2	361	Coyote willow	87%	0.82	2	700	600	40%	3.76	2	700	3,000	2,000	-47%
002_03	Devil Creek	3	183	Coyote willow	87%	0.82	2	400	300	40%	3.76	2	400	2,000	2,000	-47%
002_03	Devil Creek	4	110	Coyote willow	69%	1.94	3	300	600	70%	1.88	3	300	600	0	1%
002_03	Devil Creek	5	400	Coyote willow	58%	2.63	4	2,000	5,000	60%	2.51	4	2,000	5,000	0	2%
002_03	Devil Creek	6	1615	Coyote willow	58%	2.63	4	6,000	20,000	30%	4.39	4	6,000	30,000	10,000	-28%
002_03	Devil Creek	7	209	Coyote willow	58%	2.63	4	800	2,000	50%	3.14	4	800	3,000	1,000	-8%
002_03	Devil Creek	8	232	Coyote willow	58%	2.63	4	900	2,000	20%	5.02	4	900	5,000	3,000	-38%
002_03	Devil Creek	9	3292	Coyote willow	49%	3.20	5	20,000	60,000	20%	5.02	5	20,000	100,000	40,000	-29%
002_03	Devil Creek	10	979	Coyote willow	49%	3.20	5	5,000	20,000	50%	3.14	5	5,000	20,000	0	1%
002_03	Devil Creek	11	1642	Coyote willow	49%	3.20	5	8,000	30,000	30%	4.39	5	8,000	40,000	10,000	-19%
002_03	Devil Creek	12	1611	Coyote willow	43%	3.57	6	10,000	40,000	10%	5.64	6	10,000	60,000	20,000	-33%
002_03	Devil Creek	13	479	Coyote willow	43%	3.57	6	3,000	10,000	20%	5.02	6	3,000	20,000	10,000	-23%
002_03	Devil Creek	14	986	Coyote willow	43%	3.57	6	6,000	20,000	40%	3.76	6	6,000	20,000	0	-3%
002_03	Devil Creek	15	99	Coyote willow	43%	3.57	6	600	2,000	60%	2.51	6	600	2,000	0	17%
002_03	Devil Creek	16	127	Coyote willow	43%	3.57	6	800	3,000	30%	4.39	6	800	4,000	1,000	-13%
002_03	Devil Creek	17	1283	Coyote willow	43%	3.57	6	8,000	30,000	40%	3.76	6	8,000	30,000	0	-3%
002_03	Devil Creek	18	138	Coyote willow	43%	3.57	6	800	3,000	10%	5.64	6	800	5,000	2,000	-33%
002_03	Devil Creek	19	450	Coyote willow	43%	3.57	6	3,000	10,000	10%	5.64	6	3,000	20,000	10,000	-33%
							Totals		260,000					370,000	120,000	

Table C5. Target and existing solar loads for House Creek - source to Cedar Creek Reservoir (AU ID17040213SK005_02)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
005_02	House Creek	1	131	Shrub	96%	0.25	1	100	30	50%	3.14	1	100	300	300	-46%
005_02	House Creek	2	282	Shrub	96%	0.25	1	300	80	10%	5.64	1	300	2,000	2,000	-86%
005_02	House Creek	3	166	Shrub	96%	0.25	1	200	50	60%	2.51	1	200	500	500	-36%
005_02	House Creek	4	213	Shrub	96%	0.25	1	200	50	20%	5.02	1	200	1,000	1,000	-76%
005_02	House Creek	5	143	Shrub	96%	0.25	1	100	30	70%	1.88	1	100	200	200	-26%
005_02	House Creek	6	189	Shrub	94%	0.38	2	400	200	10%	5.64	2	400	2,000	2,000	-84%
005_02	House Creek	7	124	Shrub	94%	0.38	2	200	80	60%	2.51	2	200	500	400	-34%
005_02	House Creek	8	658	Tree_Shrub	97%	0.19	2	1,000	200	50%	3.14	2	1,000	3,000	3,000	-47%
005_02	House Creek	9	669	Shrub	90%	0.63	3	2,000	1,000	50%	3.14	3	2,000	6,000	5,000	-40%
005_02	House Creek	10	413	Shrub	90%	0.63	3	1,000	600	70%	1.88	3	1,000	2,000	1,000	-20%
005_02	House Creek	11	257	Tree_Shrub	91%	0.56	3	800	500	20%	5.02	3	800	4,000	4,000	-71%
005_02	House Creek	12	273	Tree_Shrub	91%	0.56	3	800	500	60%	2.51	3	800	2,000	2,000	-31%
005_02	House Creek	13	151	Tree_Shrub	91%	0.56	3	500	300	70%	1.88	3	500	900	600	-21%
005_02	House Creek	14	150	Tree_Shrub	91%	0.56	3	500	300	10%	5.64	3	500	3,000	3,000	-81%
005_02	House Creek	15	195	Shrub	90%	0.63	3	600	400	50%	3.14	3	600	2,000	2,000	-40%
005_02	House Creek	16	914	Tree_Shrub	91%	0.56	3	3,000	2,000	60%	2.51	3	3,000	8,000	6,000	-31%
005_02	House Creek	17	161	Tree_Shrub	91%	0.56	3	500	300	40%	3.76	3	500	2,000	2,000	-51%
005_02	House Creek	18	1031	Shrub	90%	0.63	3	3,000	2,000	60%	2.51	3	3,000	8,000	6,000	-30%
005_02	House Creek	19	345	Shrub	80%	1.25	4	1,000	1,000	70%	1.88	4	1,000	2,000	1,000	-10%
005_02	House Creek	20	149	Shrub	80%	1.25	4	600	800	60%	2.51	4	600	2,000	1,000	-20%
005_02	House Creek	21	1016	Tree_Shrub	84%	1.00	4	4,000	4,000	70%	1.88	4	4,000	8,000	4,000	-14%
005_02	House Creek	22	296	Shrub	80%	1.25	4	1,000	1,000	50%	3.14	4	1,000	3,000	2,000	-30%

005_02	House Creek	23	903	Tree_Shrub	84%	1.00	4	4,000	4,000	70%	1.88	4	4,000	8,000	4,000	-14%
005_02	House Creek	24	555	Tree_Shrub	76%	1.50	5	3,000	5,000	60%	2.51	5	3,000	8,000	3,000	-16%
005_02	House Creek	25	272	Shrub	71%	1.82	5	1,000	2,000	50%	3.14	5	1,000	3,000	1,000	-21%
005_02	House Creek	26	86	Shrub	71%	1.82	5	400	700	10%	5.64	5	400	2,000	1,000	-61%
005_02	House Creek	27	228	Shrub	71%	1.82	5	1,000	2,000	30%	4.39	5	1,000	4,000	2,000	-41%
005_02	House Creek	28	637	Shrub	71%	1.82	5	3,000	5,000	60%	2.51	5	3,000	8,000	3,000	-11%
005_02	House Creek_Trib 01	1	1524	Shrub	90%	0.63	3	5,000	3,000	60%	2.51	3	5,000	10,000	7,000	-30%
005_02	House Creek_Trib 02	1	505	Sagebrush_Grass	38%	3.89	2	1,000	4,000	10%	5.64	2	1,000	6,000	2,000	-28%
005_02	House Creek_Trib 02	2	1019	Shrub	94%	0.38	2	2,000	800	20%	5.02	2	2,000	10,000	9,000	-74%
005_02	Little House Creek	1	291	Tree_Shrub	97%	0.19	1	300	60	60%	2.51	1	300	800	700	-37%
005_02	Little House Creek	2	480	Shrub	96%	0.25	1	500	100	80%	1.25	1	500	600	500	-16%
005_02	Little House Creek	3	448	Tree_Shrub	97%	0.19	1	400	80	60%	2.51	1	400	1,000	900	-37%
005_02	Little House Creek	4	285	Shrub	94%	0.38	2	600	200	40%	3.76	2	600	2,000	2,000	-54%
005_02	Little House Creek	5	201	Shrub	94%	0.38	2	400	200	60%	2.51	2	400	1,000	800	-34%
005_02	Little House Creek	6	225	Shrub	94%	0.38	2	500	200	30%	4.39	2	500	2,000	2,000	-64%
005_02	Little House Creek	7	61	Shrub	94%	0.38	2	100	40	60%	2.51	2	100	300	300	-34%
005_02	Little House Creek	8	368	Shrub	94%	0.38	2	700	300	60%	2.51	2	700	2,000	2,000	-34%
005_02	Little House Creek	11	937	Shrub	90%	0.63	3	3,000	2,000	30%	4.39	3	3,000	10,000	8,000	-60%
005_02	Little House Creek	12	411	Shrub	90%	0.63	3	1,000	600	40%	3.76	3	1,000	4,000	3,000	-50%
005_02	Little House Creek	13	822	Shrub	90%	0.63	3	2,000	1,000	20%	5.02	3	2,000	10,000	9,000	-70%
005_02	Little House Creek	14	1876	Shrub	80%	1.25	4	8,000	10,000	20%	5.02	4	8,000	40,000	30,000	-60%
005_02	Little House Creek	15	1553	Shrub	80%	1.25	4	6,000	8,000	30%	4.39	4	6,000	30,000	20,000	-50%
005_02	Taylor Canyon Tributary	1	353	Shrub	96%	0.25	1	400	100	10%	5.64	1	400	2,000	2,000	-86%
005_02	Taylor Canyon Tributary	2	482	Tree_Shrub	95%	0.31	2	1,000	300	80%	1.25	2	1,000	1,000	700	-15%
005_02	Taylor Creek	1	728	Shrub	96%	0.25	1	700	200	10%	5.64	1	700	4,000	4,000	-86%
005_02	Taylor Creek	2	275	Shrub	96%	0.25	1	300	80	10%	5.64	1	300	2,000	2,000	-86%
005_02	Taylor Creek	3	986	Shrub	94%	0.38	2	2,000	800	70%	1.88	2	2,000	4,000	3,000	-24%

005_02	Taylor Creek	4	890	Shrub	90%	0.63	3	3,000	2,000	60%	2.51	3	3,000	8,000	6,000	-30%
							Totals		68,000					250,000	180,000	

Table C6. Target and existing solar loads for House Creek - source to Cedar Creek Reservoir (AU ID17040213SK005_03)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
005_03	House Creek	29	2015	Shrub	63%	2.32	6	10,000	20,000	60%	2.51	6	10,000	30,000	10,000	-3%
005_03	House Creek	30	103	Shrub	63%	2.32	6	600	1,000	60%	2.51	6	600	2,000	1,000	-3%
005_03	House Creek	31	346	Shrub	63%	2.32	6	2,000	5,000	40%	3.76	6	2,000	8,000	3,000	-23%
005_03	House Creek	32	591	Shrub	63%	2.32	6	4,000	9,000	50%	3.14	6	4,000	10,000	1,000	-13%
005_03	House Creek	33	47	Shrub	63%	2.32	6	300	700	20%	5.02	6	300	2,000	1,000	-43%
005_03	House Creek	34	46	Shrub	63%	2.32	6	300	700	20%	5.02	6	300	2,000	1,000	-43%
005_03	House Creek	35	143	Shrub	63%	2.32	6	900	2,000	50%	3.14	6	900	3,000	1,000	-13%
005_03	House Creek	36	402	Shrub	63%	2.32	6	2,000	5,000	40%	3.76	6	2,000	8,000	3,000	-23%
005_03	House Creek	37	114	Shrub	63%	2.32	6	700	2,000	20%	5.02	6	700	4,000	2,000	-43%
005_03	House Creek	38	298	Shrub	63%	2.32	6	2,000	5,000	50%	3.14	6	2,000	6,000	1,000	-13%
005_03	House Creek	39	389	Shrub	63%	2.32	6	2,000	5,000	50%	3.14	6	2,000	6,000	1,000	-13%
005_03	House Creek	40	1956	Shrub	57%	2.70	7	10,000	30,000	40%	3.76	7	10,000	40,000	10,000	-17%
005_03	House Creek	41	307	Shrub	57%	2.70	7	2,000	5,000	40%	3.76	7	2,000	8,000	3,000	-17%
005_03	House Creek	42	236	Shrub	57%	2.70	7	2,000	5,000	30%	4.39	7	2,000	9,000	4,000	-27%
005_03	House Creek	43	167	Shrub	57%	2.70	7	1,000	3,000	20%	5.02	7	1,000	5,000	2,000	-37%
005_03	House Creek	44	155	Shrub	57%	2.70	7	1,000	3,000	10%	5.64	7	1,000	6,000	3,000	-47%
005_03	House Creek	45	395	Shrub	57%	2.70	7	3,000	8,000	40%	3.76	7	3,000	10,000	2,000	-17%
005_03	House Creek	46	217	Shrub	57%	2.70	7	2,000	5,000	20%	5.02	7	2,000	10,000	5,000	-37%
005_03	House Creek	47	1004	Shrub	57%	2.70	7	7,000	20,000	30%	4.39	7	7,000	30,000	10,000	-27%

005_03	House Creek	48	833	Shrub	57%	2.70	7	6,000	20,000	20%	5.02	7	6,000	30,000	10,000	-37%
005_03	House Creek	49	400	Shrub	51%	3.07	8	3,000	9,000	30%	4.39	8	3,000	10,000	1,000	-21%
005_03	House Creek	50	451	Coyote willow	34%	4.14	8	4,000	20,000	40%	3.76	8	4,000	20,000	0	6%
005_03	House Creek	51	359	Coyote willow	34%	4.14	8	3,000	10,000	40%	3.76	8	3,000	10,000	0	6%
005_03	House Creek	52	2989	Coyote willow	34%	4.14	8	20,000	80,000	40%	3.76	8	20,000	80,000	0	6%
005_03	House Creek	53	297	Coyote willow	34%	4.14	8	2,000	8,000	50%	3.14	8	2,000	6,000	(2,000)	16%
005_03	House Creek	54	2444	Coyote willow	34%	4.14	8	20,000	80,000	40%	3.76	8	20,000	80,000	0	6%
005_03	Little House Creek	16	61	Shrub	80%	1.25	4	200	300	40%	3.76	4	200	800	500	-40%
							Totals		360,000					440,000	74,000	

Table C7. Target and existing solar loads for House Creek - source to Cedar Creek Reservoir (AU ID17040213SK005_04)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
005_04	House Creek	55	1381	Coyote willow	31%	4.33	9	10,000	40,000	10%	5.64	9	10,000	60,000	20,000	-21%
005_04	House Creek	56	1467	Coyote willow	31%	4.33	9	10,000	40,000	40%	3.76	9	10,000	40,000	0	9%
005_04	House Creek	57	222	Coyote willow	31%	4.33	9	2,000	9,000	40%	3.76	9	2,000	8,000	(1,000)	9%
005_04	House Creek	58	1080	Coyote willow	31%	4.33	9	10,000	40,000	10%	5.64	9	10,000	60,000	20,000	-21%
							Totals		130,000					170,000	39,000	

Table C8. Target and existing solar loads for Cedar Creek - source to Cedar Creek Reservoir (AU ID17040213SK006_02)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
006_02	Cedar Creek	1	118	Shrub	80%	1.25	4	500	600	30%	4.39	4	500	2,000	1,000	-50%
006_02	Cedar Creek	2	276	Shrub	80%	1.25	4	1,000	1,000	60%	2.51	4	1,000	3,000	2,000	-20%

006_02	Cedar Creek	3	191	Shrub	80%	1.25	4	800	1,000	50%	3.14	4	800	3,000	2,000	-30%
006_02	Cedar Creek	4	135	Shrub	80%	1.25	4	500	600	30%	4.39	4	500	2,000	1,000	-50%
006_02	Cedar Creek	5	414	Shrub	80%	1.25	4	2,000	3,000	30%	4.39	4	2,000	9,000	6,000	-50%
006_02	Cedar Creek	6	296	Shrub	80%	1.25	4	1,000	1,000	40%	3.76	4	1,000	4,000	3,000	-40%
006_02	Cedar Creek	7	932	Shrub	80%	1.25	4	4,000	5,000	50%	3.14	4	4,000	10,000	5,000	-30%
006_02	Cedar Creek	8	227	Shrub	80%	1.25	4	900	1,000	10%	5.64	4	900	5,000	4,000	-70%
006_02	Cedar Creek	9	57	Shrub	80%	1.25	4	200	300	10%	5.64	4	200	1,000	700	-70%
006_02	Cedar Creek	10	119	Shrub	80%	1.25	4	500	600	30%	4.39	4	500	2,000	1,000	-50%
006_02	Cedar Creek	11	147	Shrub	80%	1.25	4	600	800	10%	5.64	4	600	3,000	2,000	-70%
006_02	Cedar Creek	12	347	Shrub	80%	1.25	4	1,000	1,000	40%	3.76	4	1,000	4,000	3,000	-40%
006_02	Cedar Creek	13	316	Shrub	80%	1.25	4	1,000	1,000	10%	5.64	4	1,000	6,000	5,000	-70%
006_02	Cedar Creek	14	68	Shrub	80%	1.25	4	300	400	30%	4.39	4	300	1,000	600	-50%
006_02	Cedar Creek	15	284	Shrub	80%	1.25	4	1,000	1,000	10%	5.64	4	1,000	6,000	5,000	-70%
006_02	Cedar Creek	16	1515	Shrub	80%	1.25	4	6,000	8,000	40%	3.76	4	6,000	20,000	10,000	-40%
006_02	Cedar Creek	17	544	Shrub	71%	1.82	5	3,000	5,000	30%	4.39	5	3,000	10,000	5,000	-41%
006_02	Cedar Creek	18	127	Shrub	71%	1.82	5	600	1,000	60%	2.51	5	600	2,000	1,000	-11%
006_02	Cedar Creek	19	1061	Shrub	71%	1.82	5	5,000	9,000	40%	3.76	5	5,000	20,000	10,000	-31%
006_02	Cedar Creek	20	544	Shrub	71%	1.82	5	3,000	5,000	50%	3.14	5	3,000	9,000	4,000	-21%
006_02	Cedar Creek	21	520	Shrub	71%	1.82	5	3,000	5,000	40%	3.76	5	3,000	10,000	5,000	-31%
006_02	Cedar Creek	22	315	Shrub	71%	1.82	5	2,000	4,000	50%	3.14	5	2,000	6,000	2,000	-21%
006_02	Cedar Creek	23	319	Shrub	71%	1.82	5	2,000	4,000	40%	3.76	5	2,000	8,000	4,000	-31%
006_02	Indian Jim Canyon	1	2273	Sagebrush_Grass	27%	4.58	3	7,000	30,000	10%	5.64	3	7,000	40,000	10,000	-17%
							Totals		89,000					190,000	92,000	

Table C9. Target and existing solar loads for Cedar Creek - source to Cedar Creek Reservoir (AU ID17040213SK006_03)

Segment Details	Target	Existing	Summary

AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
006_03	Cedar Creek	24	404	Shrub	63%	2.32	6	2,000	5,000	40%	3.76	6	2,000	8,000	3,000	-23%
006_03	Cedar Creek	25	446	Shrub	63%	2.32	6	3,000	7,000	50%	3.14	6	3,000	9,000	2,000	-13%
006_03	Cedar Creek	26	1212	Shrub	63%	2.32	6	7,000	20,000	40%	3.76	6	7,000	30,000	10,000	-23%
006_03	Cedar Creek	27	420	Shrub	63%	2.32	6	3,000	7,000	50%	3.14	6	3,000	9,000	2,000	-13%
006_03	Cedar Creek	28	284	Shrub	63%	2.32	6	2,000	5,000	40%	3.76	6	2,000	8,000	3,000	-23%
006_03	Cedar Creek	29	433	Shrub	63%	2.32	6	3,000	7,000	40%	3.76	6	3,000	10,000	3,000	-23%
006_03	Cedar Creek	30	403	Shrub	57%	2.70	7	3,000	8,000	50%	3.14	7	3,000	9,000	1,000	-7%
006_03	Cedar Creek	31	284	Shrub	57%	2.70	7	2,000	5,000	20%	5.02	7	2,000	10,000	5,000	-37%
006_03	Cedar Creek	32	479	Shrub	57%	2.70	7	3,000	8,000	30%	4.39	7	3,000	10,000	2,000	-27%
006_03	Cedar Creek	33	356	Shrub	57%	2.70	7	2,000	5,000	50%	3.14	7	2,000	6,000	1,000	-7%
006_03	Cedar Creek	34	247	Shrub	57%	2.70	7	2,000	5,000	30%	4.39	7	2,000	9,000	4,000	-27%
006_03	Cedar Creek	35	316	Shrub	57%	2.70	7	2,000	5,000	40%	3.76	7	2,000	8,000	3,000	-17%
006_03	Cedar Creek	36	93	Shrub	57%	2.70	7	700	2,000	10%	5.64	7	700	4,000	2,000	-47%
006_03	Cedar Creek	37	230	Shrub	57%	2.70	7	2,000	5,000	10%	5.64	7	2,000	10,000	5,000	-47%
006_03	Cedar Creek	38	64	Shrub	57%	2.70	7	400	1,000	40%	3.76	7	400	2,000	1,000	-17%
006_03	Cedar Creek	39	322	Shrub	57%	2.70	7	2,000	5,000	50%	3.14	7	2,000	6,000	1,000	-7%
							Totals		100,000					150,000	48,000	

Table C10. Target and existing solar loads for China, Browns, Corral, Player Creeks(AU ID17040213SK008_02)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
008_02	Browns Creek	1	204	Shrub	96%	0.25	1	200	50	90%	0.63	1	200	100	50	-6%
008_	Browns Creek	2	159	Shrub	96%	0.25	1	200	50	90%	0.63	1	200	100	50	-6%

02																
008_02	Browns Creek	3	715	Shrub	96%	0.25	1	700	200	60%	2.51	1	700	2,000	2,000	-36%
008_02	Browns Creek	4	693	Shrub	96%	0.25	1	700	200	20%	5.02	1	700	4,000	4,000	-76%
008_02	Browns Creek	5	297	Sagebrush_Grass	64%	2.26	1	300	700	0%	6.27	1	300	2,000	1,000	-64%
008_02	Browns Creek	6	826	Sagebrush_Grass	38%	3.89	2	2,000	8,000	0%	6.27	2	2,000	10,000	2,000	-38%
008_02	Browns Creek	7	353	Sagebrush_Grass	38%	3.89	2	700	3,000	10%	5.64	2	700	4,000	1,000	-28%
008_02	Browns Creek	8	1039	Sagebrush_Grass	38%	3.89	2	2,000	8,000	20%	5.02	2	2,000	10,000	2,000	-18%
008_02	Browns Creek	9	393	Sagebrush_Grass	27%	4.58	3	1,000	5,000	30%	4.39	3	1,000	4,000	(1,000)	3%
008_02	Browns Creek	10	1087	Sagebrush_Grass	27%	4.58	3	3,000	10,000	0%	6.27	3	3,000	20,000	10,000	-27%
008_02	China Creek	1	559	Sagebrush_Grass	64%	2.26	1	600	1,000	10%	5.64	1	600	3,000	2,000	-54%
008_02	China Creek	2	188	Mountain mahogany	73%	1.69	1	200	300	30%	4.39	1	200	900	600	-43%
008_02	China Creek	3	345	Sagebrush_Grass	64%	2.26	1	300	700	10%	5.64	1	300	2,000	1,000	-54%
008_02	China Creek	4	394	Shrub	96%	0.25	1	400	100	60%	2.51	1	400	1,000	900	-36%
008_02	China Creek	5	785	Shrub	96%	0.25	1	800	200	50%	3.14	1	800	3,000	3,000	-46%
008_02	China Creek	6	699	Shrub	96%	0.25	1	700	200	60%	2.51	1	700	2,000	2,000	-36%
008_02	China Creek	7	977	Shrub	94%	0.38	2	2,000	800	30%	4.39	2	2,000	9,000	8,000	-64%
008_02	China Creek	8	429	Shrub	94%	0.38	2	900	300	60%	2.51	2	900	2,000	2,000	-34%
008_02	China Creek	9	93	Shrub	94%	0.38	2	200	80	60%	2.51	2	200	500	400	-34%
008_02	China Creek	10	499	Shrub	94%	0.38	2	1,000	400	20%	5.02	2	1,000	5,000	5,000	-74%
008_02	China Creek	11	187	Shrub	94%	0.38	2	400	200	30%	4.39	2	400	2,000	2,000	-64%
008_02	China Creek Ranch Springs	1	1196	Sagebrush_Grass	64%	2.26	1	1,000	2,000	20%	5.02	1	1,000	5,000	3,000	-44%
008_02	China Creek Ranch Springs	2	501	Sagebrush_Grass	38%	3.89	2	1,000	4,000	10%	5.64	2	1,000	6,000	2,000	-28%
008_02	China Creek Springs	1	299	Shrub	96%	0.25	1	300	80	60%	2.51	1	300	800	700	-36%
008_02	China Creek_Trib 01	1	2285	Sagebrush_Grass	64%	2.26	1	2,000	5,000	0%	6.27	1	2,000	10,000	5,000	-64%
008_02	China Creek_Trib 02	1	2365	Graminoid	31%	4.33	2	5,000	20,000	10%	5.64	2	5,000	30,000	10,000	-21%
008_02	China Creek_Trib 02	2	1582	Graminoid	21%	4.95	3	5,000	20,000	10%	5.64	3	5,000	30,000	10,000	-11%
008_02	China Creek_Trib 02	3	835	Graminoid	16%	5.27	4	3,000	20,000	20%	5.02	4	3,000	20,000	0	4%

008_02	China Creek_Trib 03	1	1427	Sagebrush_Grass	38%	3.89	2	3,000	10,000	10%	5.64	2	3,000	20,000	10,000	-28%
008_02	Corral Creek	1	364	Sagebrush_Grass	64%	2.26	1	400	900	10%	5.64	1	400	2,000	1,000	-54%
008_02	Corral Creek	2	234	Sagebrush_Grass	38%	3.89	2	500	2,000	20%	5.02	2	500	3,000	1,000	-18%
008_02	Corral Creek	3	545	Sagebrush_Grass	27%	4.58	3	2,000	9,000	0%	6.27	3	2,000	10,000	1,000	-27%
008_02	Corral Creek	4	2140	Sagebrush_Grass	96%	0.25	1	2,000	500	10%	5.64	1	2,000	10,000	10,000	-86%
008_02	Corral Creek_Trib 01	1	386	Shrub	64%	2.26	1	400	900	30%	4.39	1	400	2,000	1,000	-34%
008_02	Deer Canyon	1	969	Sagebrush_Grass	64%	2.26	1	1,000	2,000	20%	5.02	1	1,000	5,000	3,000	-44%
008_02	Deer Canyon	2	646	Sagebrush_Grass	38%	3.89	2	1,000	4,000	10%	5.64	2	1,000	6,000	2,000	-28%
008_02	Deer Canyon	3	424	Sagebrush_Grass	38%	3.89	2	800	3,000	20%	5.02	2	800	4,000	1,000	-18%
008_02	Deer Canyon	4	346	Sagebrush_Grass	27%	4.58	3	1,000	5,000	30%	4.39	3	1,000	4,000	(1,000)	3%
008_02	Deer Canyon	5	341	Sagebrush_Grass	27%	4.58	3	1,000	5,000	20%	5.02	3	1,000	5,000	0	-7%
008_02	North Canyon	1	477	Sagebrush_Grass	64%	2.26	1	500	1,000	0%	6.27	1	500	3,000	2,000	-64%
008_02	Player Creek	1	306	Mountain mahogany	73%	1.69	1	300	500	80%	1.25	1	300	400	(100)	7%
008_02	Player Creek	2	230	Mountain mahogany	73%	1.69	1	200	300	20%	5.02	1	200	1,000	700	-53%
008_02	Player Creek	3	369	Shrub	96%	0.25	1	400	100	30%	4.39	1	400	2,000	2,000	-66%
008_02	Player Creek	4	126	Shrub	94%	0.38	2	300	100	20%	5.02	2	300	2,000	2,000	-74%
008_02	Player Creek	5	312	Shrub	94%	0.38	2	600	200	50%	3.14	2	600	2,000	2,000	-44%
008_02	Player Creek	6	618	Shrub	94%	0.38	2	1,000	400	80%	1.25	2	1,000	1,000	600	-14%
008_02	Player Creek	7	776	Shrub	90%	0.63	3	2,000	1,000	70%	1.88	3	2,000	4,000	3,000	-20%
008_02	Player Creek	8	84	Shrub	90%	0.63	3	300	200	70%	1.88	3	300	600	400	-20%
								Totals	160,000					280,000	120,000	

Table C11. Target and existing solar loads for China Creek (AU ID17040213SK008_03)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade

008_03	China Creek	12	361	Shrub	90%	0.63	3	1,000	600	70%	1.88	3	1,000	2,000	1,000	-20%
008_03	China Creek	13	744	Shrub	90%	0.63	3	2,000	1,000	30%	4.39	3	2,000	9,000	8,000	-60%
008_03	China Creek	14	234	Shrub	80%	1.25	4	900	1,000	30%	4.39	4	900	4,000	3,000	-50%
008_03	China Creek	15	940	Shrub	80%	1.25	4	4,000	5,000	30%	4.39	4	4,000	20,000	20,000	-50%
008_03	China Creek	16	200	Shrub	71%	1.82	5	1,000	2,000	40%	3.76	5	1,000	4,000	2,000	-31%
008_03	China Creek	17	856	Shrub	71%	1.82	5	4,000	7,000	30%	4.39	5	4,000	20,000	10,000	-41%
008_03	China Creek	18	627	Shrub	63%	2.32	6	4,000	9,000	40%	3.76	6	4,000	20,000	10,000	-23%
008_03	China Creek	19	246	Shrub	63%	2.32	6	1,000	2,000	30%	4.39	6	1,000	4,000	2,000	-33%
008_03	China Creek	20	193	Shrub	63%	2.32	6	1,000	2,000	40%	3.76	6	1,000	4,000	2,000	-23%
008_03	China Creek	21	213	Shrub	63%	2.32	6	1,000	2,000	0%	6.27	6	1,000	6,000	4,000	-63%
008_03	China Creek	22	119	Shrub	63%	2.32	6	700	2,000	20%	5.02	6	700	4,000	2,000	-43%
							Totals		34,000					97,000	64,000	

Table C12. Target and existing solar loads for Salmon Falls Creek-Idaho/Nevada border to Salmon Falls Creek (AU ID17040213SK009_06)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
009_06	Salmon Falls Creek	1	12395	Shrub	40%	3.76	11	140,000	530,000	0%	6.27	11	140,000	880,000	350,000	-40%
							Totals		530,000					880,000	350,000	

Table C13. Target and existing solar loads for North Fork Salmon Falls Creek-source to Idaho/Nevada border (AU ID17040213SK010_02)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
010_02	Barbour Creek	1	489	Sagebrush_Grass	64%	2.26	1	500	1,000	10%	5.64	1	500	3,000	2,000	-54%
010_	Barbour Creek	2	303	Shrub	96%	0.25	1	300	80	40%	3.76	1	300	1,000	900	-56%

02																
010_ 02	Barbour Creek	3	1360	Shrub	94%	0.38	2	3,000	1,000	60%	2.51	2	3,000	8,000	7,000	-34%
010_ 02	Barbour Creek	4	211	Shrub	90%	0.63	3	600	400	40%	3.76	3	600	2,000	2,000	-50%
010_ 02	Bear Creek	1	612	Sagebrush_Gra ss	64%	2.26	1	600	1,000	10%	5.64	1	600	3,000	2,000	-54%
010_ 02	Bear Creek	2	433	Mountain mahogany	73%	1.69	1	400	700	60%	2.51	1	400	1,000	300	-13%
010_ 02	Bear Creek	3	588	Mountain mahogany	73%	1.69	1	600	1,000	50%	3.14	1	600	2,000	1,000	-23%
010_ 02	Bear Creek	4	557	Shrub	94%	0.38	2	1,000	400	20%	5.02	2	1,000	5,000	5,000	-74%
010_ 02	Bear Creek	5	1136	Shrub	94%	0.38	2	2,000	800	60%	2.51	2	2,000	5,000	4,000	-34%
010_ 02	Bear Creek Tributary	1	784	Shrub	96%	0.25	1	800	200	40%	3.76	1	800	3,000	3,000	-56%
010_ 02	Bear Creek Tributary	2	635	Shrub	94%	0.38	2	1,000	400	30%	4.39	2	1,000	4,000	4,000	-64%
010_ 02	Meadow Springs	1	510	Shrub	96%	0.25	1	500	100	50%	3.14	1	500	2,000	2,000	-46%
010_ 02	Meadow Springs	2	464	Shrub	96%	0.25	1	500	100	10%	5.64	1	500	3,000	3,000	-86%
010_ 02	Meadow Springs	3	594	Shrub	96%	0.25	1	600	200	40%	3.76	1	600	2,000	2,000	-56%
010_ 02	Meadow Springs	4	1327	Shrub	96%	0.25	1	1,000	300	60%	2.51	1	1,000	3,000	3,000	-36%
010_ 02	Meadow Springs	5	469	Shrub	94%	0.38	2	900	300	30%	4.39	2	900	4,000	4,000	-64%
010_ 02	Meadow Springs	6	257	Shrub	94%	0.38	2	500	200	60%	2.51	2	500	1,000	800	-34%
010_ 02	North Fork Salmon Falls Creek	1	224	Shrub	96%	0.25	1	200	50	60%	2.51	1	200	500	500	-36%
010_ 02	North Fork Salmon Falls Creek	2	200	Shrub	96%	0.25	1	200	50	30%	4.39	1	200	900	900	-66%
010_ 02	North Fork Salmon Falls Creek	3	1205	Shrub	96%	0.25	1	1,000	300	80%	1.25	1	1,000	1,000	700	-16%
010_ 02	North Fork Salmon Falls Creek	4	191	Shrub	96%	0.25	1	200	50	10%	5.64	1	200	1,000	1,000	-86%
010_ 02	North Fork Salmon Falls Creek	5	339	Shrub	96%	0.25	1	300	80	60%	2.51	1	300	800	700	-36%
010_ 02	North Fork Salmon Falls Creek	6	298	Shrub	94%	0.38	2	600	200	40%	3.76	2	600	2,000	2,000	-54%
010_ 02	North Fork Salmon Falls Creek	7	249	Shrub	94%	0.38	2	500	200	20%	5.02	2	500	3,000	3,000	-74%
010_ 02	North Fork Salmon Falls Creek	8	524	Shrub	94%	0.38	2	1,000	400	50%	3.14	2	1,000	3,000	3,000	-44%
010_ 02	North Fork Salmon Falls Creek	9	705	Shrub	94%	0.38	2	1,000	400	50%	3.14	2	1,000	3,000	3,000	-44%
010_ 02	Rocky Canyon Creek	1	1568	Shrub	96%	0.25	1	2,000	500	50%	3.14	1	2,000	6,000	6,000	-46%
010_ 02	Rocky Canyon Creek	2	1154	Shrub	96%	0.25	1	1,000	300	70%	1.88	1	1,000	2,000	2,000	-26%

010_02	Rocky Canyon Creek	3	403	Shrub	94%	0.38	2	800	300	30%	4.39	2	800	4,000	4,000	-64%
010_02	Rocky Canyon Creek	4	181	Shrub	90%	0.63	3	500	300	50%	3.14	3	500	2,000	2,000	-40%
							Totals		11,000					81,000	75,000	

Table C14. Target and existing solar loads for North Fork Salmon Falls Creek-source to Idaho/Nevada border (AU ID17040213SK010_03)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
010_03	North Fork Salmon Falls Creek	10	574	Shrub	80%	1.25	4	2,000	3,000	30%	4.39	4	2,000	9,000	6,000	-50%
010_03	North Fork Salmon Falls Creek	11	194	Shrub	80%	1.25	4	800	1,000	10%	5.64	4	800	5,000	4,000	-70%
010_03	North Fork Salmon Falls Creek	12	277	Shrub	71%	1.82	5	1,000	2,000	10%	5.64	5	1,000	6,000	4,000	-61%
010_03	North Fork Salmon Falls Creek	13	326	Shrub	71%	1.82	5	2,000	4,000	30%	4.39	5	2,000	9,000	5,000	-41%
010_03	North Fork Salmon Falls Creek	14	377	Shrub	71%	1.82	5	2,000	4,000	30%	4.39	5	2,000	9,000	5,000	-41%
							Totals		14,000					38,000	24,000	

Table C15. Target and existing solar loads for Shoshone Creek - Hot Creek to Idaho/Nevada border (AU ID17040213SK011_04)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
011_04	Shoshone Creek	48	6279	Shrub	43%	3.57	10	63,000	230,000	0%	6.27	10	63,000	400,000	170,000	-43%
011_04	Shoshone Creek	49	1928	Shrub	43%	3.57	10	19,000	68,000	10%	5.64	10	19,000	110,000	42,000	-33%
011_04	Shoshone Creek	50	7265	Shrub	43%	3.57	10	73,000	260,000	0%	6.27	10	73,000	460,000	200,000	-43%
							Totals		560,000					970,000	410,000	

Table C16. Target and existing solar loads for Hot Creek - Idaho/Nevada border to mouth (AU ID17040213SK012_02)

Segment Details	Target	Existing	Summary

AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
012_02	Horse Creek	1	305	Shrub	96%	0.25	1	300	80	50%	3.14	1	300	900	800	-46%
012_02	Horse Creek	2	1157	Sagebrush_Grass	64%	2.26	1	1,000	2,000	30%	4.39	1	1,000	4,000	2,000	-34%
012_02	Horse Creek	3	1409	Sagebrush_Grass	64%	2.26	1	1,000	2,000	20%	5.02	1	1,000	5,000	3,000	-44%
012_02	Horse Creek	5	517	Sagebrush_Grass	38%	3.89	2	1,000	4,000	20%	5.02	2	1,000	5,000	1,000	-18%
012_02	Horse Creek	6	1753	Sagebrush_Grass	38%	3.89	2	4,000	20,000	30%	4.39	2	4,000	20,000	0	-8%
012_02	Horse Creek	7	475	Sagebrush_Grass	27%	4.58	3	1,000	5,000	20%	5.02	3	1,000	5,000	0	-7%
012_02	Horse Creek	8	336	Sagebrush_Grass	27%	4.58	3	1,000	5,000	0%	6.27	3	1,000	6,000	1,000	-27%
012_02	Horse Creek	9	831	Sagebrush_Grass	27%	4.58	3	2,000	9,000	0%	6.27	3	2,000	10,000	1,000	-27%
012_02	Tunnel Hill Spring	1	309	Shrub	96%	0.25	1	300	80	40%	3.76	1	300	1,000	900	-56%
							Totals		47,000					57,000	9,700	

Table C17. Target and existing solar loads for Hot Creek - Idaho/Nevada border to mouth (AU ID17040213SK012_03)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
012_03	Horse Creek	12	641	Sagebrush_Grass	20%	5.02	4	3,000	20,000	10%	5.64	4	3,000	20,000	0	-10%
012_03	Horse Creek	14	409	Sagebrush_Grass	20%	5.02	4	2,000	10,000	30%	4.39	4	2,000	9,000	(1,000)	10%
012_03	Horse Creek	15	392	Sagebrush_Grass	16%	5.27	5	2,000	10,000	10%	5.64	5	2,000	10,000	0	-6%
012_03	Horse Creek	16	142	Sagebrush_Grass	16%	5.27	5	700	4,000	10%	5.64	5	700	4,000	0	-6%
012_03	Horse Creek	17	848	Sagebrush_Grass	14%	5.39	6	5,000	30,000	20%	5.02	6	5,000	30,000	0	6%
							Totals		74,000					73,000	-1,000	

Table C18. Target and existing solar loads for Hot Creek (AU ID17040213SK012_03A)

Segment Details	Target	Existing	Summary

AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
012_03A	Hot Creek	1	1739	Sagebrush_Grass	12%	5.52	7	10,000	60,000	0%	6.27	7	10,000	60,000	0	-12%
012_03A	Hot Creek	2	787	Sagebrush_Grass	10%	5.64	8	6,000	30,000	30%	4.39	8	6,000	30,000	0	20%
012_03A	Hot Creek	3	740	Sagebrush_Grass	10%	5.64	8	6,000	30,000	20%	5.02	8	6,000	30,000	0	10%
012_03A	Hot Creek	4	353	Sagebrush_Grass	10%	5.64	8	3,000	20,000	30%	4.39	8	3,000	10,000	(10,000)	20%
012_03A	Hot Creek	5	209	Sagebrush_Grass	9%	5.71	9	2,000	10,000	20%	5.02	9	2,000	10,000	0	11%
012_03A	Hot Creek	6	936	Sagebrush_Grass	9%	5.71	9	8,000	50,000	0%	6.27	9	8,000	50,000	0	-9%
012_03A	Hot Creek	7	574	Sagebrush_Grass	9%	5.71	9	5,000	30,000	0%	6.27	9	5,000	30,000	0	-9%
							Totals		230,000					220,000	-10,000	

Table C19. Target and existing solar loads for Hot Creek - Idaho/Nevada border to mouth (AU ID17040213SK012_04)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
012_04	Shoshone Creek	47	180	Shrub	51%	3.07	8	1,000	3,000	0%	6.27	8	1,000	6,000	3,000	-51%
							Totals		3,000					6,000	3,000	

Table C20. Target and existing solar loads for Shoshone Creek - Cottonwood Creek to Hot Creek (AU ID17040213SK013_04)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
013_04	Langford Flat Creek	20	150	Shrub	43%	3.57	10	1,500	5,400	30%	4.39	10	1,500	6,600	1,200	-13%
013_04	Shoshone Creek	39	772	Shrub	43%	3.57	10	7,700	28,000	30%	4.39	10	7,700	34,000	6,000	-13%
013_04	Shoshone Creek	40	1899	Shrub	43%	3.57	10	19,000	68,000	10%	5.64	10	19,000	110,000	42,000	-33%
013_0	Shoshone Creek	41	1620	Shrub	43%	3.57	10	16,000	57,000	0%	6.27	10	16,000	100,000	43,000	-43%

4																
013_04	Shoshone Creek	42	1565	Shrub	43%	3.57	10	16,000	57,000	10%	5.64	10	16,000	90,000	33,000	-33%
013_04	Shoshone Creek	43	468	Shrub	43%	3.57	10	4,700	17,000	0%	6.27	10	4,700	29,000	12,000	-43%
013_04	Shoshone Creek	44	1366	Shrub	43%	3.57	10	14,000	50,000	10%	5.64	10	14,000	79,000	29,000	-33%
013_04	Shoshone Creek	45	2693	Shrub	43%	3.57	10	27,000	96,000	0%	6.27	10	27,000	170,000	74,000	-43%
013_04	Shoshone Creek	46	2960	Shrub	43%	3.57	10	30,000	110,000	0%	6.27	10	30,000	190,000	80,000	-43%
							Totals		490,000					810,000	320,000	

Table C21. Target and existing solar loads for Big Creek - source to mouth (AU ID17040213SK014_02)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
014_02	Basque Spring	1	284	Sagebrush_Grass	64%	2.26	1	300	700	10%	5.64	1	300	2,000	1,000	-54%
014_02	Basque Spring	2	287	Sagebrush_Grass	64%	2.26	1	300	700	60%	2.51	1	300	800	100	-4%
014_02	Basque Spring	3	457	Sagebrush_Grass	38%	3.89	2	900	3,000	10%	5.64	2	900	5,000	2,000	-28%
014_02	Basque Spring	4	642	Sagebrush_Grass	38%	3.89	2	1,000	4,000	20%	5.02	2	1,000	5,000	1,000	-18%
014_02	Basque Spring	5	805	Sagebrush_Grass	38%	3.89	2	2,000	8,000	10%	5.64	2	2,000	10,000	2,000	-28%
014_02	Big Creek	1	382	Tree_Shrub	97%	0.19	1	400	80	60%	2.51	1	400	1,000	900	-37%
014_02	Big Creek	2	498	Shrub	96%	0.25	1	500	100	30%	4.39	1	500	2,000	2,000	-66%
014_02	Big Creek	3	558	Tree_Shrub	97%	0.19	1	600	100	40%	3.76	1	600	2,000	2,000	-57%
014_02	Big Creek	4	146	Shrub	96%	0.25	1	100	30	10%	5.64	1	100	600	600	-86%
014_02	Big Creek	5	444	Shrub	96%	0.25	1	400	100	60%	2.51	1	400	1,000	900	-36%
014_02	Big Creek	6	1746	Shrub	94%	0.38	2	3,000	1,000	50%	3.14	2	3,000	9,000	8,000	-44%
014_02	Big Creek	7	1679	Shrub	94%	0.38	2	3,000	1,000	50%	3.14	2	3,000	9,000	8,000	-44%
014_02	Big Creek	8	666	Tree_Shrub	95%	0.31	2	1,000	300	50%	3.14	2	1,000	3,000	3,000	-45%
014_02	Big Creek	9	1307	Tree_Shrub	91%	0.56	3	4,000	2,000	30%	4.39	3	4,000	20,000	20,000	-61%
014_02	Big Creek	10	486	Tree_Shrub	91%	0.56	3	1,000	600	40%	3.76	3	1,000	4,000	3,000	-51%

014_ 02	Big Creek	11	800	Tree_Shrub	91%	0.56	3	2,000	1,000	20%	5.02	3	2,000	10,000	9,000	-71%
014_ 02	Big Creek	12	901	Shrub	90%	0.63	3	3,000	2,000	40%	3.76	3	3,000	10,000	8,000	-50%
014_ 02	Big Creek	13	259	Shrub	80%	1.25	4	1,000	1,000	20%	5.02	4	1,000	5,000	4,000	-60%
014_ 02	Big Creek	14	482	Shrub	80%	1.25	4	2,000	3,000	40%	3.76	4	2,000	8,000	5,000	-40%
014_ 02	Big Creek	15	228	Shrub	80%	1.25	4	900	1,000	40%	3.76	4	900	3,000	2,000	-40%
014_ 02	Big Creek	16	542	Shrub	80%	1.25	4	2,000	3,000	30%	4.39	4	2,000	9,000	6,000	-50%
014_ 02	Big Creek	17	1133	Shrub	80%	1.25	4	5,000	6,000	40%	3.76	4	5,000	20,000	10,000	-40%
014_ 02	Big Creek	18	458	Shrub	80%	1.25	4	2,000	3,000	20%	5.02	4	2,000	10,000	7,000	-60%
014_ 02	Big Creek	19	964	Shrub	71%	1.82	5	5,000	9,000	30%	4.39	5	5,000	20,000	10,000	-41%
014_ 02	Big Creek	20	989	Shrub	71%	1.82	5	5,000	9,000	10%	5.64	5	5,000	30,000	20,000	-61%
014_ 02	Big Creek	21	708	Shrub	71%	1.82	5	4,000	7,000	20%	5.02	5	4,000	20,000	10,000	-51%
014_ 02	Big Creek	22	456	Shrub	71%	1.82	5	2,000	4,000	10%	5.64	5	2,000	10,000	6,000	-61%
014_ 02	Big Creek_Trib 01	1	571	Shrub	96%	0.25	1	600	200	40%	3.76	1	600	2,000	2,000	-56%
014_ 02	Big Creek_Trib 01	2	368	Shrub	96%	0.25	1	400	100	30%	4.39	1	400	2,000	2,000	-66%
014_ 02	Big Creek_Trib 01	3	406	Shrub	94%	0.38	2	800	300	50%	3.14	2	800	3,000	3,000	-44%
014_ 02	Big Creek_Trib 01	4	237	Shrub	94%	0.38	2	500	200	10%	5.64	2	500	3,000	3,000	-84%
014_ 02	Dry Gulch	1	327	Shrub	96%	0.25	1	300	80	60%	2.51	1	300	800	700	-36%
014_ 02	Dry Gulch	2	627	Shrub	96%	0.25	1	600	200	50%	3.14	1	600	2,000	2,000	-46%
014_ 02	Dry Gulch	3	1739	Shrub	94%	0.38	2	3,000	1,000	60%	2.51	2	3,000	8,000	7,000	-34%
014_ 02	Middle Fork Hannahs Fork	1	553	Shrub	96%	0.25	1	600	200	50%	3.14	1	600	2,000	2,000	-46%
014_ 02	Middle Fork Hannahs Fork	2	783	Shrub	94%	0.38	2	2,000	800	40%	3.76	2	2,000	8,000	7,000	-54%
014_ 02	Middle Fork Hannahs Fork	3	82	Shrub	94%	0.38	2	200	80	10%	5.64	2	200	1,000	900	-84%
014_ 02	Middle Fork Hannahs Fork	4	72	Sagebrush_Grass	38%	3.89	2	100	400	10%	5.64	2	100	600	200	-28%
014_ 02	North Fork Hannahs Fork	1	603	Tree_Shrub	97%	0.19	1	600	100	50%	3.14	1	600	2,000	2,000	-47%
014_ 02	North Fork Hannahs Fork	2	1145	Tree_Shrub	95%	0.31	2	2,000	600	60%	2.51	2	2,000	5,000	4,000	-35%
014_ 02	North Fork Hannahs Fork	3	441	Sagebrush_Grass	38%	3.89	2	900	3,000	10%	5.64	2	900	5,000	2,000	-28%
014_ 02	South Hannahs Fork	1	682	Sagebrush_Grass	64%	2.26	1	700	2,000	10%	5.64	1	700	4,000	2,000	-54%

014_02	South Hannahs Fork	2	862	Sagebrush_Grass	38%	3.89	2	2,000	8,000	0%	6.27	2	2,000	10,000	2,000	-38%
014_02	South Hannahs Fork	3	274	Sagebrush_Grass	38%	3.89	2	500	2,000	10%	5.64	2	500	3,000	1,000	-28%
014_02	Willow Spring Creek	1	448	Shrub	96%	0.25	1	400	100	50%	3.14	1	400	1,000	900	-46%
							Totals		90,000					290,000	200,000	

Table C22. Target and solar loads for Big Creek - source to mouth (AU ID17040213SK014_03)

Segment Details					Target					Existing					Summary	
AU	**Stream Name**	**Number (top to bottom)**	**Length (m)**	**Vegetation Type**	**Shade**	**Solar Radiation (kWh/m²/day)**	**Segment Width (m)**	**Segment Area (m²)**	**Solar Load (kWh/day)**	**Shade**	**Solar Radiation (kWh/m²/day)**	**Segment Width (m)**	**Segment Area (m²)**	**Solar Load (kWh/day)**	**Excess Load (kWh/day)**	**Lack of Shade**
014_03	Big Creek	22	1737	Shrub	63%	2.32	6	10,000	20,000	10%	5.64	6	10,000	60,000	40,000	-53%
014_03	Big Creek	23	300	Shrub	63%	2.32	6	2,000	5,000	20%	5.02	6	2,000	10,000	5,000	-43%
014_03	Big Creek	24	102	Shrub	63%	2.32	6	600	1,000	30%	4.39	6	600	3,000	2,000	-33%
014_03	Big Creek	25	714	Shrub	63%	2.32	6	4,000	9,000	20%	5.02	6	4,000	20,000	10,000	-43%
014_03	Big Creek	26	208	Shrub	57%	2.70	7	1,000	3,000	10%	5.64	7	1,000	6,000	3,000	-47%
014_03	Big Creek	27	1157	Shrub	57%	2.70	7	8,000	20,000	10%	5.64	7	8,000	50,000	30,000	-47%
014_03	Big Creek	28	307	Shrub	57%	2.70	7	2,000	5,000	20%	5.02	7	2,000	10,000	5,000	-37%
014_03	Big Creek	29	574	Shrub	57%	2.70	7	4,000	10,000	10%	5.64	7	4,000	20,000	10,000	-47%
014_03	Hannahs Fork	1	438	Shrub	90%	0.63	3	1,000	600	50%	3.14	3	1,000	3,000	2,000	-40%
014_03	Hannahs Fork	2	579	Shrub	90%	0.63	3	2,000	1,000	60%	2.51	3	2,000	5,000	4,000	-30%
014_03	Hannahs Fork	3	1622	Shrub	90%	0.63	3	5,000	3,000	40%	3.76	3	5,000	20,000	20,000	-50%
014_03	Hannahs Fork	4	1087	Shrub	90%	0.63	3	3,000	2,000	20%	5.02	3	3,000	20,000	20,000	-70%
014_03	Hannahs Fork	5	485	Sagebrush_Grass	27%	4.58	3	1,000	5,000	10%	5.64	3	1,000	6,000	1,000	-17%
014_03	Hannahs Fork	6	392	Sagebrush_Grass	27%	4.58	3	1,000	5,000	0%	6.27	3	1,000	6,000	1,000	-27%
014_03	Hannahs Fork	7	560	Sagebrush_Grass	27%	4.58	3	2,000	9,000	10%	5.64	3	2,000	10,000	1,000	-17%
								Totals	99,000					250,000	150,000	

Table C23. Target and existing solar loads for Cottonwood Creek - source to mouth (AU ID17040213SK015_02)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
015_02	Cottonwood Creek	1	357	Shrub	94%	0.38	2	700	300	10%	5.64	2	700	4,000	4,000	-84%
015_02	Cottonwood Creek	2	670	Shrub	94%	0.38	2	1,000	400	20%	5.02	2	1,000	5,000	5,000	-74%
015_02	Cottonwood Creek	3	736	Shrub	90%	0.63	3	2,000	1,000	30%	4.39	3	2,000	9,000	8,000	-60%
015_02	Cottonwood Creek	4	584	Tree_Shrub	84%	1.00	4	2,000	2,000	20%	5.02	4	2,000	10,000	8,000	-64%
015_02	Cottonwood Creek	5	417	Shrub	80%	1.25	4	2,000	3,000	10%	5.64	4	2,000	10,000	7,000	-70%
015_02	Cottonwood Creek	6	162	Shrub	80%	1.25	4	600	800	0%	6.27	4	600	4,000	3,000	-80%
015_02	Cottonwood Creek	7	888	Shrub	80%	1.25	4	4,000	5,000	10%	5.64	4	4,000	20,000	20,000	-70%
015_02	Cottonwood Creek	8	582	Tree_Shrub	84%	1.00	4	2,000	2,000	20%	5.02	4	2,000	10,000	8,000	-64%
015_02	Cottonwood Creek	9	2287	Tree_Shrub	76%	1.50	5	10,000	20,000	10%	5.64	5	10,000	60,000	40,000	-66%
015_02	Cottonwood Creek	10	537	Shrub	71%	1.82	5	3,000	5,000	30%	4.39	5	3,000	10,000	5,000	-41%
015_02	Cottonwood Creek	11	2058	Shrub	71%	1.82	5	10,000	20,000	20%	5.02	5	10,000	50,000	30,000	-51%
015_02	Cottonwood Creek	12	243	Shrub	71%	1.82	5	1,000	2,000	50%	3.14	5	1,000	3,000	1,000	-21%
015_02	Cottonwood Creek	13	275	Shrub	71%	1.82	5	1,000	2,000	20%	5.02	5	1,000	5,000	3,000	-51%
015_02	Cottonwood Creek	14	87	Shrub	71%	1.82	5	400	700	20%	5.02	5	400	2,000	1,000	-51%
015_02	Cottonwood Creek	15	470	Shrub	71%	1.82	5	2,000	4,000	30%	4.39	5	2,000	9,000	5,000	-41%
015_02	Cottonwood Creek	16	726	Shrub	71%	1.82	5	4,000	7,000	20%	5.02	5	4,000	20,000	10,000	-51%
015_02	Cottonwood Creek	17	157	Shrub	71%	1.82	5	800	1,000	10%	5.64	5	800	5,000	4,000	-61%
015_02	Cottonwood Creek	18	806	Shrub	63%	2.32	6	5,000	10,000	20%	5.02	6	5,000	30,000	20,000	-43%
015_02	Cottonwood Creek	19	703	Shrub	63%	2.32	6	4,000	9,000	10%	5.64	6	4,000	20,000	10,000	-53%
015_02	Cottonwood Creek	20	913	Shrub	63%	2.32	6	5,000	10,000	20%	5.02	6	5,000	30,000	20,000	-43%
015_02	Cottonwood Creek	21	1544	Shrub	63%	2.32	6	9,000	20,000	30%	4.39	6	9,000	40,000	20,000	-33%
015_02	Cottonwood Creek_Trib 01	1	240	Shrub	96%	0.25	1	200	50	90%	0.63	1	200	100	50	-6%

015_ 02	Cottonwood Creek_Trib 01	2	252	Shrub	96%	0.25	1	300	80	10%	5.64	1	300	2,000	2,000	-86%
015_ 02	Cottonwood Creek_Trib 01	3	904	Shrub	94%	0.38	2	2,000	800	40%	3.76	2	2,000	8,000	7,000	-54%
015_ 02	Diamond Creek	1	193	Shrub	96%	0.25	1	200	50	20%	5.02	1	200	1,000	1,000	-76%
015_ 02	Diamond Creek	2	184	Shrub	96%	0.25	1	200	50	30%	4.39	1	200	900	900	-66%
015_ 02	Diamond Creek	3	393	Shrub	96%	0.25	1	400	100	40%	3.76	1	400	2,000	2,000	-56%
015_ 02	Diamond Creek	4	736	Shrub	96%	0.25	1	700	200	30%	4.39	1	700	3,000	3,000	-66%
015_ 02	Diamond Creek	5	405	Shrub	94%	0.38	2	800	300	20%	5.02	2	800	4,000	4,000	-74%
015_ 02	Diamond Creek	6	371	Shrub	94%	0.38	2	700	300	40%	3.76	2	700	3,000	3,000	-54%
015_ 02	Diamond Creek	7	476	Shrub	94%	0.38	2	1,000	400	60%	2.51	2	1,000	3,000	3,000	-34%
015_ 02	Eagle Spring Creek	1	521	Tree_Shrub	97%	0.19	1	500	90	80%	1.25	1	500	600	500	-17%
015_ 02	Eagle Spring Creek	2	356	Tree_Shrub	97%	0.19	1	400	80	60%	2.51	1	400	1,000	900	-37%
015_ 02	Eagle Spring Creek	3	467	Tree_Shrub	97%	0.19	1	500	90	70%	1.88	1	500	900	800	-27%
015_ 02	Eagle Spring Creek	4	555	Tree_Shrub	95%	0.31	2	1,000	300	40%	3.76	2	1,000	4,000	4,000	-55%
015_ 02	Eagle Spring Creek	5	314	Shrub	94%	0.38	2	600	200	60%	2.51	2	600	2,000	2,000	-34%
015_ 02	Eagle Spring Creek	6	132	Shrub	94%	0.38	2	300	100	20%	5.02	2	300	2,000	2,000	-74%
015_ 02	Jack Creek	1	155	Shrub	96%	0.25	1	200	50	40%	3.76	1	200	800	800	-56%
015_ 02	Jack Creek	2	167	Tree_Shrub	97%	0.19	1	200	40	80%	1.25	1	200	300	300	-17%
015_ 02	Jack Creek	3	330	Tree_Shrub	97%	0.19	1	300	60	20%	5.02	1	300	2,000	2,000	-77%
015_ 02	Jack Creek	4	297	Tree_Shrub	97%	0.19	1	300	60	80%	1.25	1	300	400	300	-17%
015_ 02	Jack Creek	5	141	Shrub	96%	0.25	1	100	30	10%	5.64	1	100	600	600	-86%
015_ 02	Jack Creek	6	640	Shrub	96%	0.25	1	600	200	60%	2.51	1	600	2,000	2,000	-36%
015_ 02	Jack Creek	7	363	Shrub	94%	0.38	2	700	300	40%	3.76	2	700	3,000	3,000	-54%
015_ 02	Jack Creek	8	425	Tree_Shrub	95%	0.31	2	900	300	70%	1.88	2	900	2,000	2,000	-25%
015_ 02	Jack Creek	9	264	Tree_Shrub	95%	0.31	2	500	200	50%	3.14	2	500	2,000	2,000	-45%
015_ 02	Jack Creek	10	559	Shrub	94%	0.38	2	1,000	400	60%	2.51	2	1,000	3,000	3,000	-34%
015_ 02	Lamb Spring	1	246	Tree_Shrub	97%	0.19	1	200	40	90%	0.63	1	200	100	60	-7%
015_ 02	Lamb Spring	2	200	Tree_Shrub	97%	0.19	1	200	40	20%	5.02	1	200	1,000	1,000	-77%

015_ 02	Lamb Spring	3	98	Tree_Shrub	97%	0.19	1	100	20	90%	0.63	1	100	60	40	-7%
015_ 02	Lamb Spring	4	161	Tree_Shrub	97%	0.19	1	200	40	20%	5.02	1	200	1,000	1,000	-77%
015_ 02	Lamb Spring	5	358	Tree_Shrub	97%	0.19	1	400	80	90%	0.63	1	400	300	200	-7%
015_ 02	Lamb Spring	6	132	Sagebrush_Gr ass	64%	2.26	1	100	200	0%	6.27	1	100	600	400	-64%
015_ 02	Lamb Spring	7	121	Tree_Shrub	97%	0.19	1	100	20	70%	1.88	1	100	200	200	-27%
015_ 02	Lamb Spring	8	369	Sagebrush_Gr ass	94%	0.38	1	400	200	0%	6.27	1	400	3,000	3,000	-94%
015_ 02	Lamb Spring	9	385	Tree_Shrub	97%	0.19	1	400	80	60%	2.51	1	400	1,000	900	-37%
015_ 02	Lamb Spring	10	430	Shrub	96%	0.25	1	400	100	40%	3.76	1	400	2,000	2,000	-56%
015_ 02	Lamb Spring	11	547	Shrub	96%	0.25	1	500	100	30%	4.39	1	500	2,000	2,000	-66%
015_ 02	Lamb Spring	12	338	Shrub	94%	0.38	2	700	300	60%	2.51	2	700	2,000	2,000	-34%
015_ 02	Lamb Spring	13	182	Shrub	94%	0.38	2	400	200	40%	3.76	2	400	2,000	2,000	-54%
015_ 02	Lamb Spring	14	433	Tree_Shrub	95%	0.31	2	900	300	20%	5.02	2	900	5,000	5,000	-75%
015_ 02	Lamb Spring	15	440	Shrub	94%	0.38	2	900	300	30%	4.39	2	900	4,000	4,000	-64%
015_ 02	Lamb Spring	16	402	Shrub	94%	0.38	2	800	300	20%	5.02	2	800	4,000	4,000	-74%
015_ 02	Lamb Spring	17	499	Shrub	94%	0.38	2	1,000	400	30%	4.39	2	1,000	4,000	4,000	-64%
015_ 02	Langford Flat Creek	1	89	Tree_Shrub	95%	0.31	2	200	60	50%	3.14	2	200	600	500	-45%
015_ 02	Langford Flat Creek	2	68	Tree_Shrub	95%	0.31	2	100	30	10%	5.64	2	100	600	600	-85%
015_ 02	Langford Flat Creek	3	86	Tree_Shrub	95%	0.31	2	200	60	50%	3.14	2	200	600	500	-45%
015_ 02	Langford Flat Creek	4	207	Tree_Shrub	95%	0.31	2	400	100	30%	4.39	2	400	2,000	2,000	-65%
015_ 02	Langford Flat Creek	5	432	Shrub	94%	0.38	2	900	300	10%	5.64	2	900	5,000	5,000	-84%
015_ 02	Pond Spring	1	696	Sagebrush_Gr ass	64%	2.26	1	700	2,000	0%	6.27	1	700	4,000	2,000	-64%
015_ 02	Pond Spring	2	189	Tree_Shrub	95%	0.31	2	400	100	40%	3.76	2	400	2,000	2,000	-55%
015_ 02	Pond Spring	3	201	Tree_Shrub	95%	0.31	2	400	100	0%	6.27	2	400	3,000	3,000	-95%
015_ 02	Pond Spring	4	222	Tree_Shrub	95%	0.31	2	400	100	90%	0.63	2	400	300	200	-5%
015_ 02	Van Eaton Spring	1	465	Shrub	94%	0.38	2	900	300	20%	5.02	2	900	5,000	5,000	-74%
015_ 02	Van Eaton Spring	2	524	Shrub	94%	0.38	2	1,000	400	60%	2.51	2	1,000	3,000	3,000	-34%
015_ 02	Van Eaton Spring	3	1454	Shrub	90%	0.63	3	4,000	3,000	40%	3.76	3	4,000	20,000	20,000	-50%

						Totals		140,000					490,000	360,000	

Table C24. Target and existing solar loads for Cottonwood Creek - source to mouth (AU ID17040213SK015_03)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
015_03	Langford Flat Creek	6	190	Shrub	90%	0.63	3	600	400	20%	5.02	3	600	3,000	3,000	-70%
015_03	Langford Flat Creek	7	67	Shrub	90%	0.63	3	200	100	20%	5.02	3	200	1,000	900	-70%
015_03	Langford Flat Creek	8	264	Shrub	90%	0.63	3	800	500	10%	5.64	3	800	5,000	5,000	-80%
015_03	Langford Flat Creek	9	340	Tree_Shrub	91%	0.56	3	1,000	600	60%	2.51	3	1,000	3,000	2,000	-31%
015_03	Langford Flat Creek	10	302	Tree_Shrub	91%	0.56	3	900	500	70%	1.88	3	900	2,000	2,000	-21%
015_03	Langford Flat Creek	11	213	Tree_Shrub	91%	0.56	4	900	500	30%	4.39	4	900	4,000	4,000	-61%
015_03	Langford Flat Creek	12	1142	Shrub	80%	1.25	4	5,000	6,000	10%	5.64	4	5,000	30,000	20,000	-70%
015_03	Langford Flat Creek	13	553	Sagebrush_Grass	16%	5.27	5	3,000	20,000	0%	6.27	5	3,000	20,000	0	-16%
015_03	Langford Flat Creek	14	615	Shrub	71%	1.82	5	3,000	5,000	10%	5.64	5	3,000	20,000	20,000	-61%
015_03	Langford Flat Creek	15	595	Shrub	63%	2.32	6	4,000	9,000	30%	4.39	6	4,000	20,000	10,000	-33%
015_03	Langford Flat Creek	16	88	Shrub	63%	2.32	6	500	1,000	10%	5.64	6	500	3,000	2,000	-53%
015_03	Langford Flat Creek	17	609	Shrub	63%	2.32	6	4,000	9,000	20%	5.02	6	4,000	20,000	10,000	-43%
015_03	Langford Flat Creek	18	449	Shrub	57%	2.70	7	3,000	8,000	20%	5.02	7	3,000	20,000	10,000	-37%
						Totals			61,000					150,000	89,000	

Table C25. Target and existing solar loads for Shoshone Creek - source to Cottonwood Creek (AU ID17040213SK016_02)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
016_	Bone Spring	1	140	Tree_Shr	97%	0.19	1	100	20	20%	5.02	1	100	500	500	-77%

02				ub												
016_ 02	Bone Spring	2	223	Grass	54%	2.88	1	200	600	10%	5.64	1	200	1,000	400	-44%
016_ 02	Bone Spring	3	64	Grass	54%	2.88	1	60	200	0%	6.27	1	60	400	200	-54%
016_ 02	Bone Spring	4	195	Grass	54%	2.88	1	200	600	10%	5.64	1	200	1,000	400	-44%
016_ 02	Bone Spring	5	439	Shrub	96%	0.25	1	400	100	30%	4.39	1	400	2,000	2,000	-66%
016_ 02	Bone Spring	6	434	Grass	54%	2.88	1	400	1,000	10%	5.64	1	400	2,000	1,000	-44%
016_ 02	Bone Spring	7	257	Grass	54%	2.88	1	300	900	0%	6.27	1	300	2,000	1,000	-54%
016_ 02	Bone Spring	8	226	Grass	54%	2.88	1	200	600	10%	5.64	1	200	1,000	400	-44%
016_ 02	Bone Spring	9	187	Grass	54%	2.88	1	200	600	20%	5.02	1	200	1,000	400	-34%
016_ 02	Bone Spring	10	216	Grass	54%	2.88	1	200	600	10%	5.64	1	200	1,000	400	-44%
016_ 02	Bone Spring	11	208	Grass	54%	2.88	1	200	600	20%	5.02	1	200	1,000	400	-34%
016_ 02	Hopper Gulch	1	664	Grass	54%	2.88	1	700	2,000	10%	5.64	1	700	4,000	2,000	-44%
016_ 02	Hopper Gulch	2	470	Grass	54%	2.88	1	500	1,000	20%	5.02	1	500	3,000	2,000	-34%
016_ 02	Hopper Gulch	3	314	Grass	54%	2.88	1	300	900	30%	4.39	1	300	1,000	100	-24%
016_ 02	Hopper Gulch	4	583	Grass	54%	2.88	1	600	2,000	10%	5.64	1	600	3,000	1,000	-44%
016_ 02	Hopper Gulch	5	895	Grass	31%	4.33	2	2,000	9,000	20%	5.02	2	2,000	10,000	1,000	-11%
016_ 02	Hopper Gulch	6	308	Grass	31%	4.33	2	600	3,000	10%	5.64	2	600	3,000	0	-21%
016_ 02	Hopper Gulch	7	432	Shrub	94%	0.38	2	900	300	30%	4.39	2	900	4,000	4,000	-64%
016_ 02	Middle Fork Shoshone Creek	1	712	Tree_Shr ub	97%	0.19	1	700	100	90%	0.63	1	700	400	300	-7%
016_ 02	Middle Fork Shoshone Creek	2	403	Shrub	96%	0.25	1	400	100	70%	1.88	1	400	800	700	-26%
016_ 02	Middle Fork Shoshone Creek	3	445	Shrub	96%	0.25	1	400	100	50%	3.14	1	400	1,000	900	-46%
016_ 02	Middle Fork Shoshone Creek	4	493	Shrub	96%	0.25	1	500	100	70%	1.88	1	500	900	800	-26%
016_ 02	Middle Fork Shoshone Creek	5	2139	Shrub	94%	0.38	2	4,000	2,000	60%	2.51	2	4,000	10,000	8,000	-34%
016_ 02	Middle Fork Shoshone Creek	6	423	Shrub	90%	0.63	3	1,000	600	50%	3.14	3	1,000	3,000	2,000	-40%
016_ 02	Middle Fork Shoshone Creek	7	1264	Shrub	90%	0.63	3	4,000	3,000	60%	2.51	3	4,000	10,000	7,000	-30%
016_ 02	Middle Fork Shoshone Creek	8	615	Shrub	90%	0.63	3	2,000	1,000	70%	1.88	3	2,000	4,000	3,000	-20%
016_ 02	Nelson Spring	1	386	Grass	21%	4.95	3	1,000	5,000	10%	5.64	3	1,000	6,000	1,000	-11%

016_02	Nelson Spring	2	534	Grass	21%	4.95	3	2,000	10,000	10%	5.64	3	2,000	10,000	0	-11%
016_02	Nelson Spring	4	1344	Grass	21%	4.95	3	4,000	20,000	20%	5.02	3	4,000	20,000	0	-1%
016_02	Nelson Spring	5	1541	Grass	16%	5.27	4	6,000	30,000	10%	5.64	4	6,000	30,000	0	-6%
016_02	Pole Camp Creek	1	711	Grass	54%	2.88	1	700	2,000	40%	3.76	1	700	3,000	1,000	-14%
016_02	Pole Camp Creek	2	487	Tree_Shrub	97%	0.19	1	500	90	60%	2.51	1	500	1,000	900	-37%
016_02	Pole Camp Creek	3	157	Tree_Shrub	97%	0.19	1	200	40	40%	3.76	1	200	800	800	-57%
016_02	Pole Camp Creek	4	200	Grass	54%	2.88	1	200	600	10%	5.64	1	200	1,000	400	-44%
016_02	Pole Camp Creek	5	117	Grass	54%	2.88	1	100	300	40%	3.76	1	100	400	100	-14%
016_02	Pole Camp Creek	6	212	Grass	54%	2.88	1	200	600	10%	5.64	1	200	1,000	400	-44%
016_02	Pole Camp Creek	7	176	Tree_Shrub	97%	0.19	1	200	40	40%	3.76	1	200	800	800	-57%
016_02	Pole Camp Creek	8	153	Tree_Shrub	97%	0.19	1	200	40	50%	3.14	1	200	600	600	-47%
016_02	Pole Camp Creek	9	613	Tree_Shrub	97%	0.19	1	600	100	40%	3.76	1	600	2,000	2,000	-57%
016_02	Pole Camp Creek	10	286	Tree_Shrub	95%	0.31	2	600	200	50%	3.14	2	600	2,000	2,000	-45%
016_02	Pole Camp Creek	11	189	Tree_Shrub	95%	0.31	2	400	100	60%	2.51	2	400	1,000	900	-35%
016_02	Pole Camp Creek	12	202	Tree_Shrub	95%	0.31	2	400	100	50%	3.14	2	400	1,000	900	-45%
016_02	Pole Camp Creek	13	278	Shrub	94%	0.38	2	600	200	10%	5.64	2	600	3,000	3,000	-84%
016_02	Pole Camp Creek	14	76	Tree_Shrub	95%	0.31	2	200	60	10%	5.64	2	200	1,000	900	-85%
016_02	Pole Camp Creek	15	1373	Tree_Shrub	95%	0.31	2	3,000	900	40%	3.76	2	3,000	10,000	9,000	-55%
016_02	Pole Camp Creek	16	1373	Shrub	90%	0.63	3	4,000	3,000	40%	3.76	3	4,000	20,000	20,000	-50%
016_02	Pole Camp Creek	17	144	Shrub	90%	0.63	3	400	300	10%	5.64	3	400	2,000	2,000	-80%
016_02	Pole Camp Creek	18	336	Shrub	90%	0.63	3	1,000	600	50%	3.14	3	1,000	3,000	2,000	-40%
016_02	Pole Camp Creek	19	510	Shrub	90%	0.63	3	2,000	1,000	30%	4.39	3	2,000	9,000	8,000	-60%
016_02	Pole Camp Creek_Trib 01	1	302	Tree_Shrub	97%	0.19	1	300	60	40%	3.76	1	300	1,000	900	-57%
016_02	Pole Camp Creek_Trib 01	2	375	Tree_Shrub	97%	0.19	1	400	80	60%	2.51	1	400	1,000	900	-37%
016_02	Pole Camp Creek_Trib 01	3	373	Tree_Shrub	97%	0.19	1	400	80	40%	3.76	1	400	2,000	2,000	-57%
016_02	Pole Camp Creek_Trib 01	4	730	Tree_Shrub	97%	0.19	1	700	100	60%	2.51	1	700	2,000	2,000	-37%
016_02	Pole Camp Creek_Trib 02	2	549	Tree_Shrub	97%	0.19	1	500	90	10%	5.64	1	500	3,000	3,000	-87%

016_02	Pole Camp Creek_Trib 02	3	480	Tree_Shrub	97%	0.19	1	500	90	20%	5.02	1	500	3,000	3,000	-77%
016_02	Pole Camp Creek_Trib 02	4	800	Grass	31%	4.33	2	2,000	9,000	0%	6.27	2	2,000	10,000	1,000	-31%
016_02	Pole Camp Creek_Trib 02	5	441	Grass	31%	4.33	2	900	4,000	20%	5.02	2	900	5,000	1,000	-11%
016_02	Shoshone Creek	1	301	Tree_Shrub	97%	0.19	1	300	60	90%	0.63	1	300	200	100	-7%
016_02	Shoshone Creek	2	546	Tree_Shrub	97%	0.19	1	500	90	70%	1.88	1	500	900	800	-27%
016_02	Shoshone Creek	3	522	Tree_Shrub	95%	0.31	2	1,000	300	80%	1.25	2	1,000	1,000	700	-15%
016_02	Shoshone Creek	4	721	Shrub	90%	0.63	3	2,000	1,000	70%	1.88	3	2,000	4,000	3,000	-20%
016_02	Shoshone Creek	5	249	Shrub	90%	0.63	3	700	400	60%	2.51	3	700	2,000	2,000	-30%
016_02	Shoshone Creek_Trib 02	1	210	Shrub	96%	0.25	1	200	50	30%	4.39	1	200	900	900	-66%
016_02	South Fork Shoshone Creek	2	561	Tree_Shrub	97%	0.19	1	600	100	90%	0.63	1	600	400	300	-7%
016_02	South Fork Shoshone Creek	3	312	Shrub	96%	0.25	1	300	80	60%	2.51	1	300	800	700	-36%
016_02	South Fork Shoshone Creek	4	393	Tree_Shrub	97%	0.19	1	400	80	50%	3.14	1	400	1,000	900	-47%
016_02	South Fork Shoshone Creek	5	497	Shrub	96%	0.25	1	500	100	40%	3.76	1	500	2,000	2,000	-56%
016_02	South Fork Shoshone Creek	6	352	Shrub	94%	0.38	2	700	300	50%	3.14	2	700	2,000	2,000	-44%
016_02	South Fork Shoshone Creek	7	870	Tree_Shrub	97%	0.19	2	2,000	400	60%	2.51	2	2,000	5,000	5,000	-37%
016_02	South Fork Shoshone Creek	8	587	Tree_Shrub	91%	0.56	3	2,000	1,000	70%	1.88	3	2,000	4,000	3,000	-21%
016_02	South Fork Shoshone Creek	9	602	Shrub	90%	0.63	3	2,000	1,000	60%	2.51	3	2,000	5,000	4,000	-30%
016_02	South Fork Shoshone Creek_Trib 01	1	147	Tree_Shrub	97%	0.19	1	100	20	90%	0.63	1	100	60	40	-7%
016_02	South Fork Shoshone Creek_Trib 01	2	665	Tree_Shrub	97%	0.19	1	700	100	80%	1.25	1	700	900	800	-17%
016_02	South Fork Shoshone Creek_Trib 01	3	355	Shrub	96%	0.25	1	400	100	20%	5.02	1	400	2,000	2,000	-76%
016_02	South Fork Shoshone Creek_Trib 01	4	277	Tree_Shrub	97%	0.19	1	300	60	90%	0.63	1	300	200	100	-7%
016_02	South Fork Shoshone Creek_Trib 01	5	1014	Tree_Shrub	97%	0.19	1	1,000	200	80%	1.25	1	1,000	1,000	800	-17%
016_02	South Fork Shoshone Creek_Trib 01	6	465	Grass	54%	2.88	1	500	1,000	20%	5.02	1	500	3,000	2,000	-34%
016_02	Summit Spring	1	470	Shrub	96%	0.25	1	500	100	50%	3.14	1	500	2,000	2,000	-46%
016_02	Summit Spring	2	621	Shrub	96%	0.25	1	600	200	80%	1.25	1	600	800	600	-16%
016_02	Summit Spring	3	679	Shrub	94%	0.38	2	1,000	400	60%	2.51	2	1,000	3,000	3,000	-34%
016_02	Summit Spring	4	270	Tree_Shrub	97%	0.19	2	500	90	80%	1.25	2	500	600	500	-17%

Totals	130,000	270,000	150,000

Table C26 Target and existing solar loads for Shoshone Creek - source to Cottonwood Creek (AU ID17040213SK016_03)

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
016_03	Langford Flat Creek	19	91	Shrub	57%	2.70	7	600	2,000	10%	5.64	7	600	3,000	1,000	-47%
016_03	Shoshone Creek	6	801	Shrub	63%	2.32	6	5,000	10,000	20%	5.02	6	5,000	30,000	20,000	-43%
016_03	Shoshone Creek	7	303	Tree_Shrub	68%	2.01	6	2,000	4,000	30%	4.39	6	2,000	9,000	5,000	-38%
016_03	Shoshone Creek	8	808	Shrub	57%	2.70	7	6,000	20,000	10%	5.64	7	6,000	30,000	10,000	-47%
016_03	Shoshone Creek	9	1343	Shrub	57%	2.70	7	9,000	20,000	10%	5.64	7	9,000	50,000	30,000	-47%
016_03	Shoshone Creek	10	1273	Tree_Shrub	55%	2.82	8	10,000	30,000	20%	5.02	8	10,000	50,000	20,000	-35%
016_03	Shoshone Creek	11	302	Tree_Shrub	55%	2.82	8	2,000	6,000	20%	5.02	8	2,000	10,000	4,000	-35%
016_03	Shoshone Creek	12	265	Tree_Shrub	51%	3.07	9	2,000	6,000	30%	4.39	9	2,000	9,000	3,000	-21%
016_03	Shoshone Creek	13	282	Tree_Shrub	51%	3.07	9	3,000	9,000	0%	6.27	9	3,000	20,000	10,000	-51%
016_03	Shoshone Creek	14	553	Shrub	47%	3.32	9	5,000	20,000	20%	5.02	9	5,000	30,000	10,000	-27%
016_03	Shoshone Creek	15	278	Tree_Shrub	47%	3.32	10	2,800	9,300	40%	3.76	10	2,800	11,000	1,700	-7%
016_03	Shoshone Creek	16	89	Tree_Shrub	47%	3.32	10	890	3,000	30%	4.39	10	890	3,900	900	-17%
016_03	Shoshone Creek	17	261	Tree_Shrub	47%	3.32	10	2,600	8,600	30%	4.39	10	2,600	11,000	2,400	-17%
016_03	Shoshone Creek	18	87	Tree_Shrub	47%	3.32	10	870	2,900	30%	4.39	10	870	3,800	900	-17%
016_03	Shoshone Creek	19	211	Tree_Shrub	47%	3.32	10	2,100	7,000	0%	6.27	10	2,100	13,000	6,000	-47%
016_03	Shoshone Creek	20	358	Tree_Shrub	47%	3.32	10	3,600	12,000	20%	5.02	10	3,600	18,000	6,000	-27%
016_03	Shoshone Creek	21	193	Shrub	43%	3.57	10	1,900	6,800	50%	3.14	10	1,900	6,000	(800)	7%
016_03	Shoshone Creek	22	299	Shrub	43%	3.57	10	3,000	11,000	20%	5.02	10	3,000	15,000	4,000	-23%
016_03	Shoshone Creek	23	642	Tree_Shrub	47%	3.32	10	6,400	21,000	40%	3.76	10	6,400	24,000	3,000	-7%
016_03	Shoshone Creek	24	396	Tree_Shrub	47%	3.32	10	4,000	13,000	30%	4.39	10	4,000	18,000	5,000	-17%
016_0	Shoshone Creek	25	352	Tree_Shr	47%	3.32	10	3,500	12,000	40%	3.76	10	3,500	13,000	1,000	-7%

3				ub												
016_0 3	Shoshone Creek	26	388	Shrub	43%	3.57	10	3,900	14,000	20%	5.02	10	3,900	20,000	6,000	-23%
016_0 3	Shoshone Creek	27	997	Shrub	43%	3.57	10	10,000	36,000	20%	5.02	10	10,000	50,000	14,000	-23%
016_0 3	Shoshone Creek	28	175	Shrub	43%	3.57	10	1,800	6,400	30%	4.39	10	1,800	7,900	1,500	-13%
016_0 3	Shoshone Creek	29	379	Shrub	43%	3.57	10	3,800	14,000	20%	5.02	10	3,800	19,000	5,000	-23%
016_0 3	Shoshone Creek	30	538	Shrub	43%	3.57	10	5,400	19,000	10%	5.64	10	5,400	30,000	11,000	-33%
016_0 3	Shoshone Creek	31	179	Shrub	43%	3.57	10	1,800	6,400	0%	6.27	10	1,800	11,000	4,600	-43%
016_0 3	Shoshone Creek	32	454	Shrub	43%	3.57	10	4,500	16,000	20%	5.02	10	4,500	23,000	7,000	-23%
016_0 3	Shoshone Creek	33	884	Shrub	43%	3.57	10	8,800	31,000	30%	4.39	10	8,800	39,000	8,000	-13%
016_0 3	Shoshone Creek	34	420	Shrub	43%	3.57	10	4,200	15,000	30%	4.39	10	4,200	18,000	3,000	-13%
016_0 3	Shoshone Creek	35	559	Shrub	43%	3.57	10	5,600	20,000	20%	5.02	10	5,600	28,000	8,000	-23%
016_0 3	Shoshone Creek	36	363	Shrub	43%	3.57	10	3,600	13,000	30%	4.39	10	3,600	16,000	3,000	-13%
016_0 3	Shoshone Creek	37	1504	Shrub	43%	3.57	10	15,000	54,000	30%	4.39	10	15,000	66,000	12,000	-13%
016_0 3	Shoshone Creek	38	228	Shrub	43%	3.57	10	2,300	8,200	20%	5.02	10	2,300	12,000	3,800	-23%
016_0 3	South Fork Shoshone Creek	10	172	Shrub	80%	1.25	4	700	900	30%	4.39	4	700	3,000	2,000	-50%
016_0 3	South Fork Shoshone Creek	11	329	Shrub	80%	1.25	4	1,000	1,000	40%	3.76	4	1,000	4,000	3,000	-40%
016_0 3	South Fork Shoshone Creek	12	473	Shrub	80%	1.25	4	2,000	3,000	40%	3.76	4	2,000	8,000	5,000	-40%
016_0 3	South Fork Shoshone Creek	13	76	Shrub	80%	1.25	4	300	400	10%	5.64	4	300	2,000	2,000	-70%
016_0 3	South Fork Shoshone Creek	14	338	Shrub	71%	1.82	5	2,000	4,000	40%	3.76	5	2,000	8,000	4,000	-31%
016_0 3	South Fork Shoshone Creek	15	620	Shrub	71%	1.82	5	3,000	5,000	10%	5.64	5	3,000	20,000	20,000	-61%
							Totals		500,000					760,000	270,000	

Existing, Target, and Shade Deficit Figures

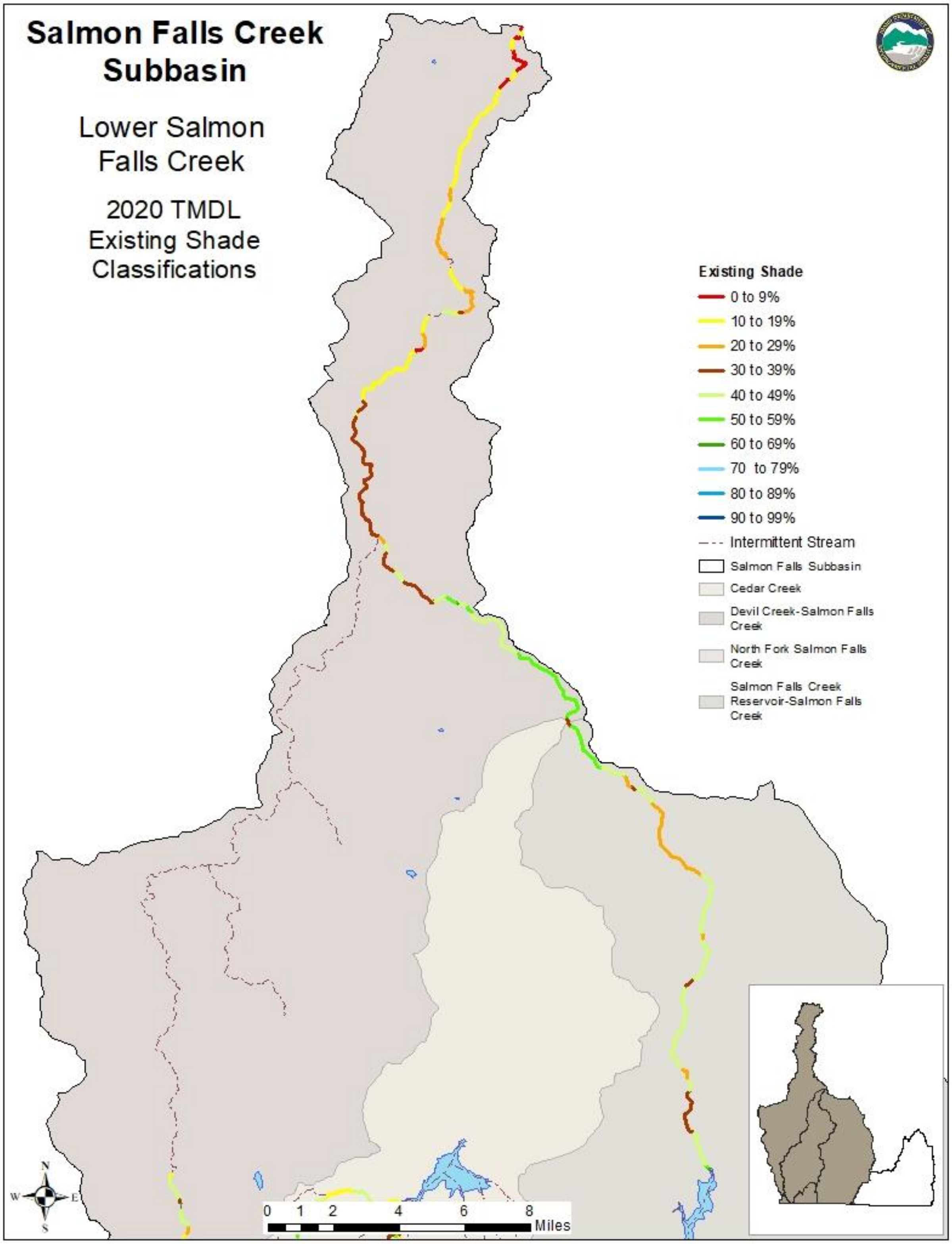


Figure C25. Lower Salmon Falls Creek existing shade levels

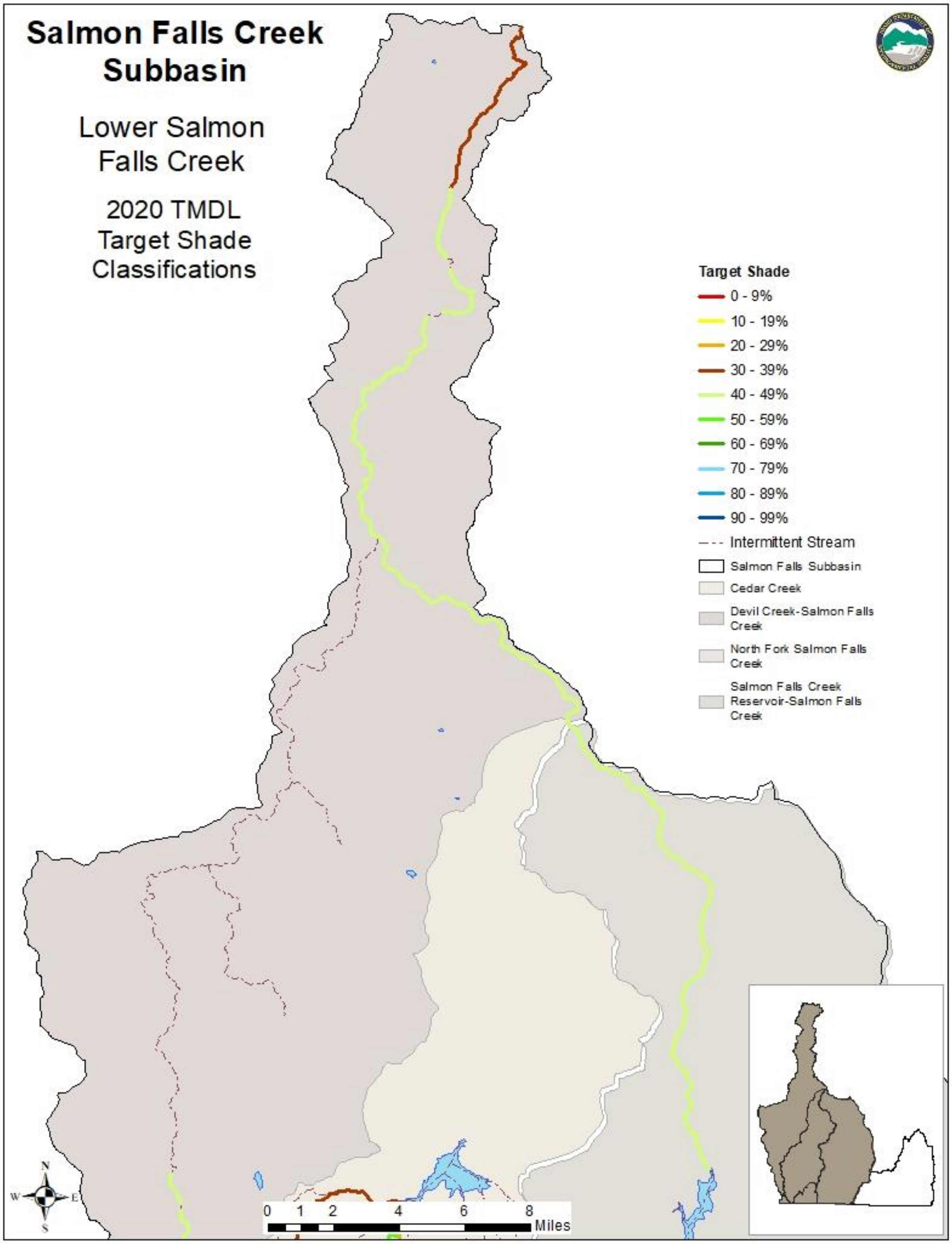


Figure C26. Lower Salmon Falls Creek target shade levels

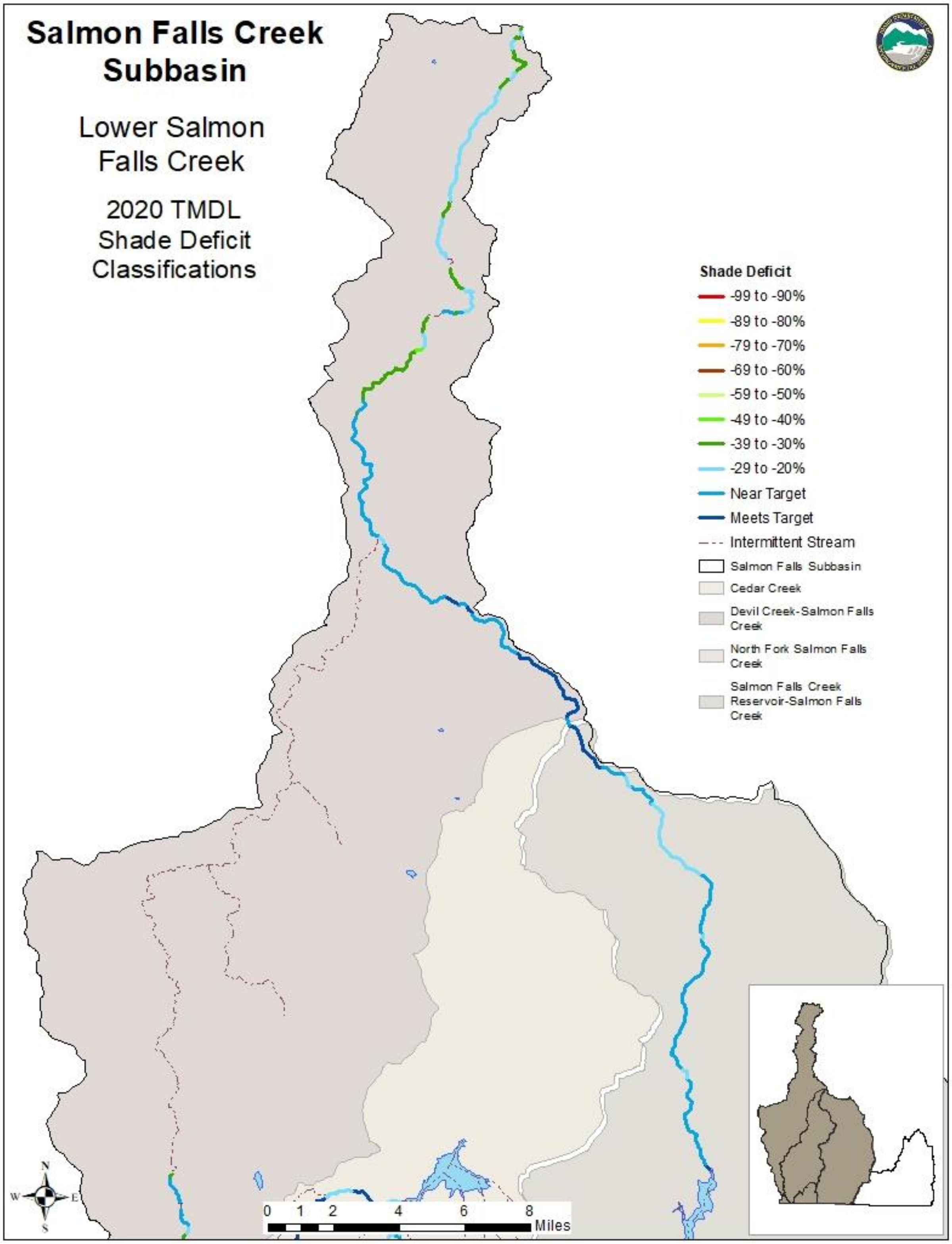


Figure C27. Lower Salmon Falls Creek shade deficit levels

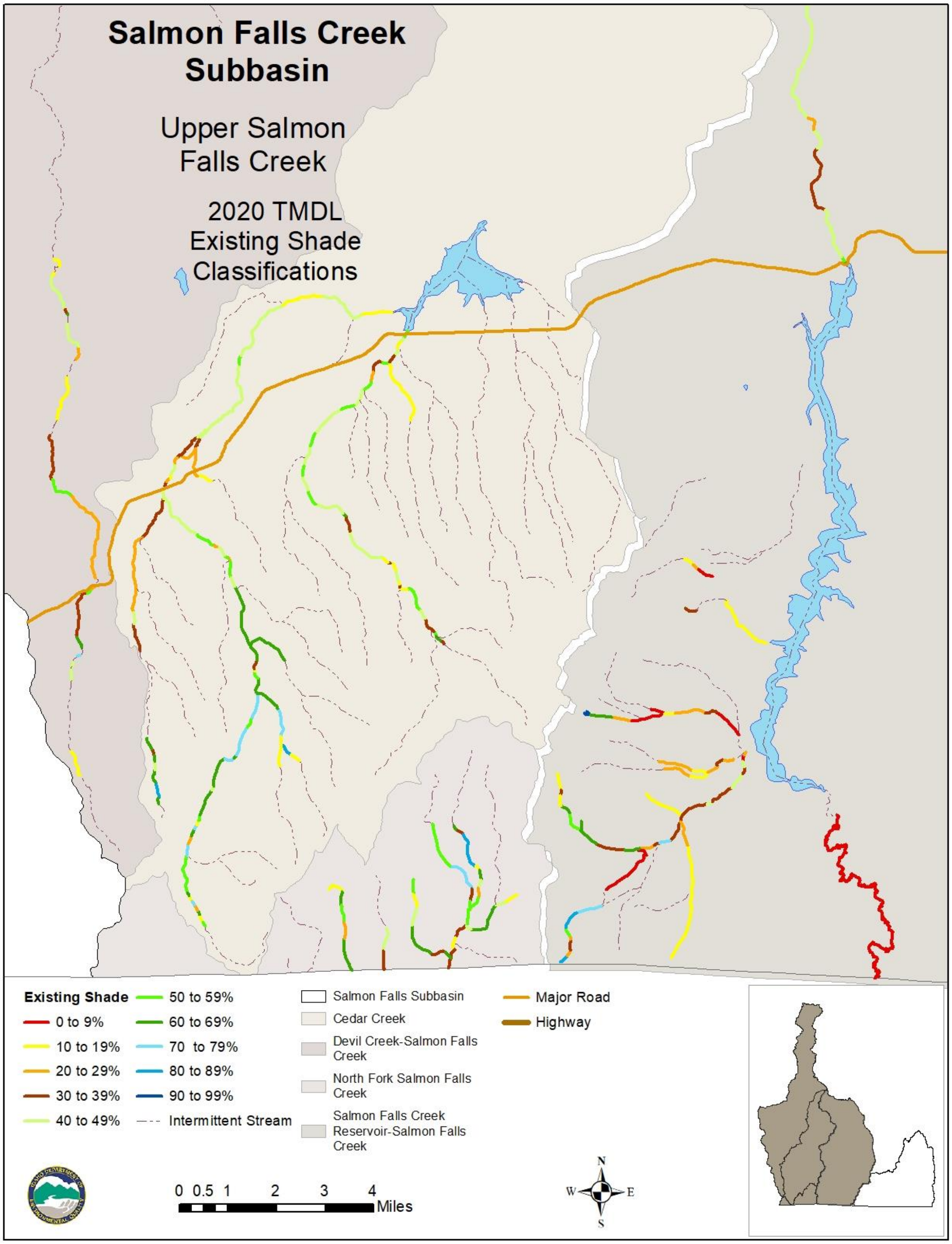


Figure C28. Upper Salmon Falls Creek existing shade levels

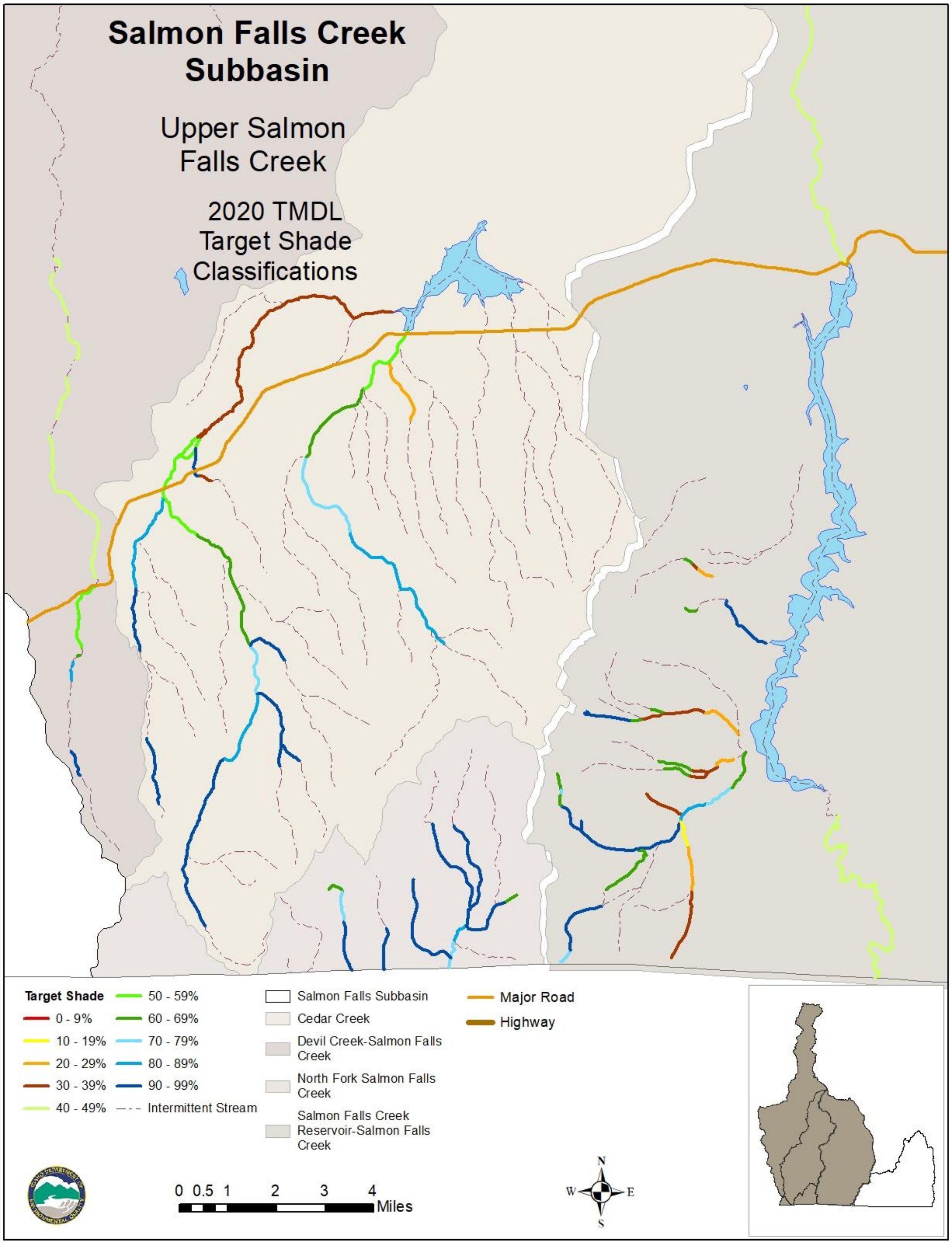


Figure C29. Upper Salmon Falls Creek target shade levels

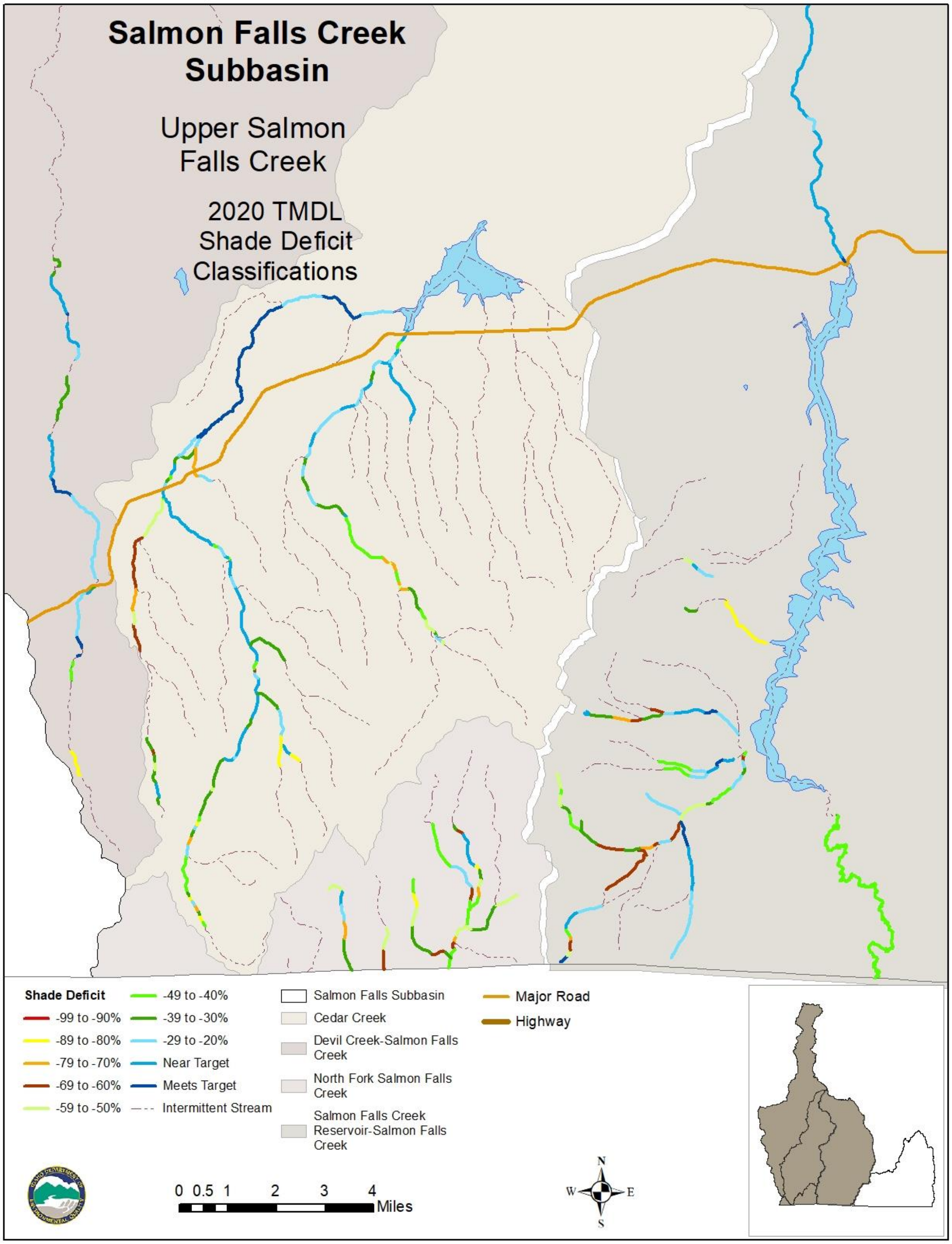


Figure C30. Upper Salmon Falls Creek shade deficit levels

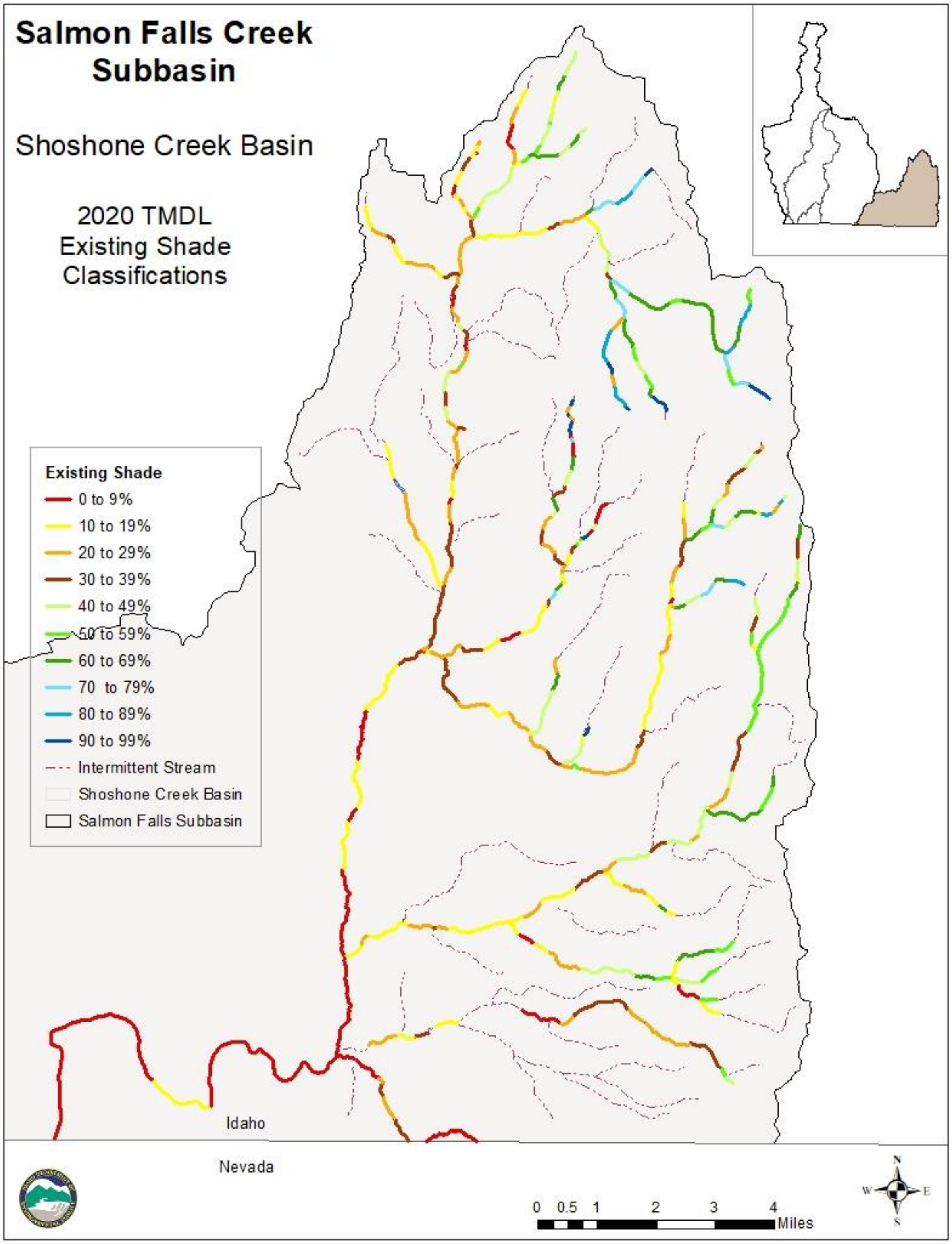


Figure C31. Shoshone Creek existing shade levels

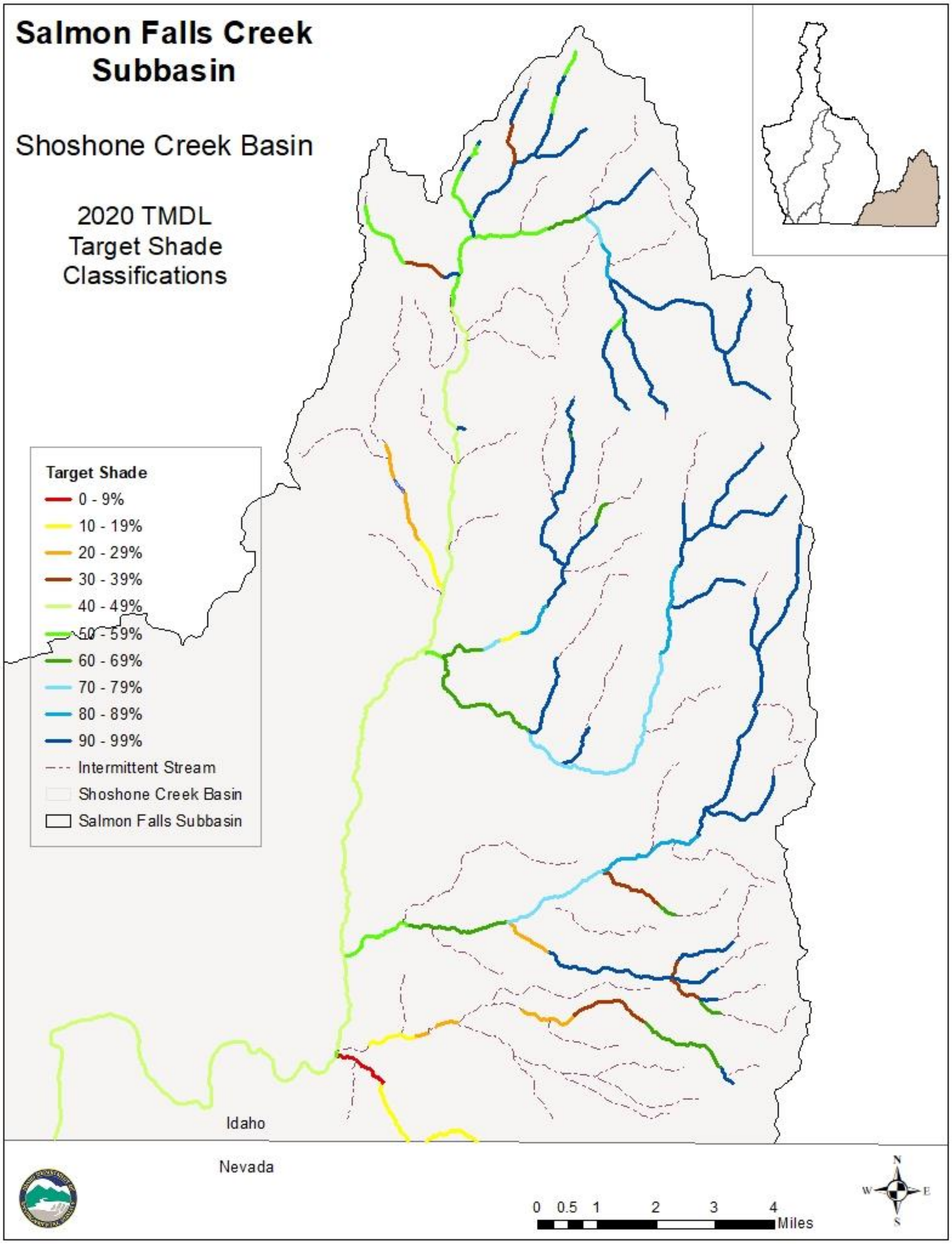


Figure C32. Shoshone Creek target shade levels

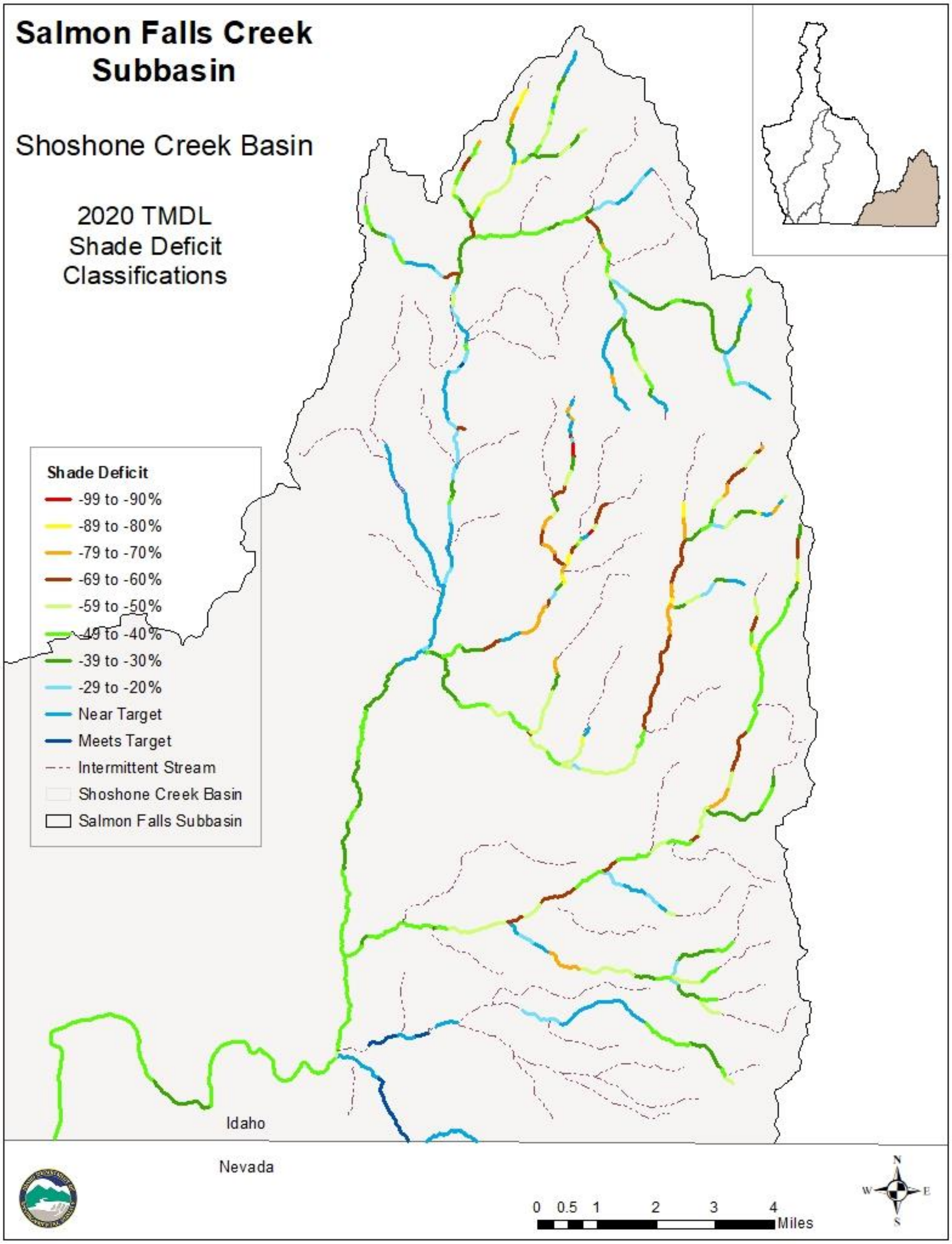


Figure C33. Shoshone Creek shade deficit levels

Appendix D. Managing Stormwater

Municipal Separate Storm Sewer Systems (MS4)

Stormwater is the surface runoff that results from rain and snow melt. Urban development alters the land's natural infiltration, and human activity generates a host of pollutants that can accumulate on paved surfaces. Uncontrolled stormwater discharges from urban areas can negatively impact water quality. The National Pollutant Discharge Elimination System (NPDES) regulations establish permit requirements for discharges from regulated municipal separate storm sewer systems (MS4s) located in U.S. Census-defined Urbanized Area (UA). The terms "municipal separate storm sewer" and "small municipal separate storm sewer system" are defined at 40 CFR §122.26(b)(8) and (b)(16), respectively. MS4s include any publicly-owned conveyance or system of conveyances used for collecting and conveying stormwater that discharge to waters of the United States. MS4s are designed for conveying stormwater only, and are not part of a combined sewer system, nor part of a publicly owned treatment works. Such a system may include roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains.1 In Idaho, various public entities own and/or operate MS4s, including, but not limited to: cities and counties; local highway districts; Idaho Transportation Department; and colleges and universities.

Polluted stormwater runoff is commonly transported through municipal separate storm sewer systems (MS4s), from which it is often discharged untreated into local water bodies. An MS4, according to 40 CFR 122.26(b)(8), is a conveyance or system of conveyances that meets the following criteria:

- Owned by a state, city, town, village, or other public entity that discharges to waters of the US
- Designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.)
- Not a combined sewer
- Not part of a publicly owned treatment works (sewage treatment plant)

To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain an National Pollutant Discharge Elimination System (NPDES) permit from the US Environmental Protection Agency (EPA), implement a comprehensive municipal stormwater management program (SWMP), and use BMPs to control pollutants in stormwater discharges to the maximum extent practicable.

Industrial Stormwater Requirements

Stormwater runoff picks up industrial pollutants and typically discharges them into nearby water bodies directly or indirectly via storm sewer systems. When facility practices allow exposure of industrial materials to stormwater, runoff from industrial areas can contain toxic pollutants (e.g., heavy metals and organic chemicals) and other pollutants such as trash, debris, and oil and grease. This increased flow and pollutant load can impair water bodies, degrade biological habitats, pollute drinking water sources, and cause flooding and hydrologic changes, such as channel erosion, to the receiving water body.

Multi-Sector General Permit (MSGP) and Stormwater Pollution Prevention Plans (SWPPP)

In Idaho, if an industrial facility discharges industrial stormwater into waters of the US, the facility must be permitted under EPA's most recent Multi-Sector General Permit (MSGP). To obtain an MSGP, the facility must prepare a stormwater pollution prevention plan (SWPPP) before submitting a notice of intent for permit coverage. The SWPPP must document the site description, design, and installation of control measures; describe monitoring procedures; and summarize potential pollutant sources. A copy of the SWPPP must be kept on site in a format that is accessible to workers and inspectors and be updated to reflect changes in site conditions, personnel, and stormwater infrastructure. Contents of the SWPPP must include:

- Stormwater pollution prevention team
- Site description
- Summary of potential sources
- Description of control measures
- Schedules and procedures
- Documentation to support eligibility considerations under other federal laws
- Signature requirements

Industrial Facilities Discharging to Impaired Water Bodies

Any facility that discharges to an impaired water body must monitor all pollutants for which the water body is impaired and for which a standard analytical method exists (see 40 CFR Part 136).

Also, because different industrial activities have sector-specific types of material that may be exposed to stormwater, EPA grouped the different regulated industries into 29 sectors, based on their typical activities. Part 8 of EPA's MSGP details the stormwater management practices and monitoring that are required for the different industrial sectors. DEQ anticipates including specific requirements for impaired waters as a condition of the 401 certification. The MSGP will detail the specific monitoring requirements.

TMDL Industrial Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a wasteload allocation for industrial stormwater activities under the MSGP. However, most load analyses developed in the past have not identified sector-specific numeric wasteload allocations for industrial stormwater activities. Industrial stormwater activities are considered in compliance with provisions of the TMDL if operators obtain an MSGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The next MSGP will have specific monitoring requirements that must be followed.

New dischargers or existing dischargers wishing to expand their discharge to high-quality waters are only eligible for coverage under the MSGP if the discharger establishes, to the satisfaction of EPA and DEQ, that the new or expanded discharge will not result in an increase in the concentration of pollutants relevant to the use for which the water is considered high quality, or that the increase constitutes insignificant degradation as defined in the WQS (IDAPA 58.01.02.052.08.a).

A new discharger or an existing discharger wishing to expand must include an analysis regarding whether the new or expanded discharge will cause an increase in the pollutants relevant to the use for which the water is considered high quality, and if there is an increase, whether that increase constitutes insignificant degradation in the Notice Of Intent (NOI), or in the planned changes report. These NOIs and planned changes reports must be submitted to both EPA and DEQ.

Construction Stormwater

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. Since 1992, EPA has issued a series of Construction General Permits (CGPs) that cover areas where EPA is the NPDES permitting authority. At present, EPA is the permitting authority in Idaho, until July 1, 2021, which is the date Idaho becomes authorized to implement the NPDES Stormwater program). In Idaho, EPA has issued a general permit for stormwater discharges from construction sites.

Construction General Permit (CGP) and Stormwater Pollution Prevention Plans

If a construction project disturbs more than 1 acre of land (or is part of a larger common development that will disturb more than 1 acre), the operator is required to apply for a CGP from EPA after developing a site-specific SWPPP. The SWPPP is intended to serve as a road map for how the construction operator will comply with the effluent limits and other conditions the CGP. If there were multiple operators associated with the same site, they may develop a group SWPPP instead of multiple individual SWPPPs. The SWPPP must provide for the erosion, sediment, and pollution controls they intend to use; inspection of the controls periodically; and maintenance of BMPs throughout the life of the project. Operators are required to keep a current copy of their SWPPP on site or at an easily accessible location.

TMDL Construction Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a gross wasteload allocation for anticipated construction stormwater activities. Most loads developed in the past did not have a numeric wasteload allocation for construction stormwater activities. Construction stormwater activities are considered in compliance with provisions of the TMDL if operators obtain a CGP under the NPDES program and implement the appropriate BMPs. Typically, operators must also follow specific requirements to be consistent with any local pollutant allocations. The CGP has monitoring requirements that must be followed. Part 3.2 of the CGP states that operators will be informed if any additional controls are necessary for the discharge to be consistent with the assumptions of any available wasteload allocation in the TMDL. These provisions are intended to implement the requirements of 40 CFR 122.44(d)(1)(vii)(B), which requires that water quality-based effluent limits in permits be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge" and of 40 CFR 122.4(i), which contains requirements regarding the issuance of permits for new sources.

Postconstruction Stormwater Management

Many communities throughout Idaho are currently developing rules for postconstruction stormwater management. Sediment is usually the main pollutant of concern in construction site stormwater. DEQ's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (DEQ 2005b) should be used to select the proper suite of BMPs for the specific site, soils, climate, and project phasing in order to sufficiently meet the standards and requirements of the CGP to protect water quality. Where local ordinances have more stringent and site-specific standards, those are applicable.

Appendix E. Pollutant Trading

Pollutant trading (also known as water quality trading) is a contractual agreement to exchange pollution reductions between two parties. Pollutant trading is a business-like way of helping to solve water quality problems by focusing on cost-effective, local solutions to problems caused by pollutant discharges to surface waters. Pollutant trading is one of the tools available to meet reductions called for in a TMDL where point and nonpoint sources both exist in a watershed.

The appeal of trading emerges when pollutant sources face substantially different pollutant reduction costs. Typically, a party facing relatively high pollutant reduction costs compensates another party to achieve an equivalent, though less costly, pollutant reduction.

Pollutant trading is voluntary. Parties trade only if both are better off because of the trade, and trading allows parties to decide how to best reduce pollutant loadings within the limits of certain requirements.

Pollutant trading is recognized in Idaho's water quality standards at IDAPA 58.01.02.055.06. DEQ allows for pollutant trading as a means to meet TMDLs, thus restoring water quality limited water bodies to compliance with water quality standards. DEQ's *Water Quality Trading Guidance* sets forth the procedures to be followed for pollutant trading (DEQ 2016b).

Trading Components

The major components of pollutant trading are trading parties (buyers and sellers) and credits (the commodity being bought and sold). Ratios are used to ensure environmental equivalency of trades on water bodies covered by a TMDL. All trading activity must be recorded in the trading database by DEQ or its designated party.

Both point and nonpoint sources may create marketable credits, which are a reduction of a pollutant beyond a level set by a TMDL:

- Point sources create credits by reducing pollutant discharges below NPDES effluent limits set initially by the wasteload allocation.
- Nonpoint sources create credits by implementing approved BMPs that reduce the amount of pollutant runoff. Nonpoint sources must follow specific design, maintenance, and monitoring requirements for that BMP; apply discounts to credits generated, if required; and provide a water quality contribution to ensure a net environmental benefit. The water quality contribution also ensures the reduction (the marketable credit) is surplus to the reductions the TMDL assumes the nonpoint source is achieving to meet the water quality goals of the TMDL.

Watershed-Specific Environmental Protection

Trades must be implemented so that the overall water quality of the water bodies covered by the TMDL is protected. To do this, hydrologically based ratios are developed to ensure trades between sources distributed throughout TMDL water bodies result in environmentally equivalent or better outcomes at the point of environmental concern. Moreover, localized adverse impacts to water quality are not allowed.

Trading Framework

For pollutant trading to be authorized, it must be specifically mentioned within a TMDL document. After adoption of an EPA-approved TMDL, DEQ, in concert with the WAG, must develop a pollutant trading framework document. The framework would mesh with the implementation plan for the watershed that is the subject of the TMDL. The elements of a trading document are described in DEQ’s pollutant trading guidance (DEQ 2016b).

Appendix F. Public Participation and Public Comments

This TMDL was developed with participation from the Mid Snake WAG through informal review and comments received during the public comment period.

[Public comments and DEQ responses to be inserted following public comment period.]

Appendix G. Distribution List

[To be inserted following public comment period.]